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Oviedo, junio 2008

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PORTADA DE *Iberus*

Iberus gualtieranus (Linnaeus, 1758), una especie emblemática de la península Ibérica, que da nombre a la revista. Dibujo realizado por José Luis González Rebollar "Toza".

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Re-discovery of living specimens of *Heliacus* (*Gyriscus*) *jeffreysianus* (Tiberi, 1867) (Gastropoda: Architectonicidae)

Redescubrimiento de ejemplares vivos de *Heliacus* (*Gyriscus*) *jeffreysianus* (Tiberi, 1867) (Gastropoda: Architectonicidae)

Constantine MIFSUD* and Panayotis OVALIS**

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ABSTRACT

Heliacus (*Gyriscus*) *jeffreysianus* (Tiberi, 1867), a rare architectonicid species associated with *Corallium rubrum* (L., 1758), has been rediscovered alive off Crete, eastern Mediterranean.

RESUMEN

Heliacus (*Gyriscus*) *jeffreysianus* (Tiberi, 1867), una especia rara de architectonicido asociado a *Corallium rubrum* (Linnaeus, 1758), ha sido redescubierta con ejemplares vivos, frente a la isla de Creta en el Mediterráneo oriental.

KEY WORDS: Mollusca, Gastropoda, Architectonicidae, *Heliacus jeffreysianus*, Crete.
PALABRAS CLAVE: Mollusca, Gastropoda, Architectonicidae, *Heliacus jeffreysianus*, Creta.

INTRODUCTION

Heliacus (*Gyriscus*) *jeffreysianus* was described by TIBERI (1867) from three specimens collected from a red coral substratum off Sardinia. He described the species a year after its discovery, as stated by COEN (1932).

SYSTEMATICS

Original description: *Cochlea turbinata, elato-conica, turrita, modice umbilicata, inteofulvescens; apex obtusiusculus, laevigatus, vertice intorto, subperforato, spiraliter involuto; anfr. 7 convexi, sutura profunda divisim transverse cingulati, cingulis confortis, alternatim majoribus (num. fere 15 totidemque minaribus in ultima anfractu; num. 6 in penultimo), eleganter granulosis, submoniliformibus; anfr. Ultimus rotundatus, subinflatus, basi paululum depressus; umbilicus mediocris, pervius, superne circolariter crenulatus; apert. Subcircularis, effusa, intus haud margaritacea, marginibus acutis, callo parietali junctis; margine columellari sinuato, reflexo, umbilici partem occultante. – Diam. Maj. 9, min. 8, alt 10? mill. – Operculum corneum, superne nucleo centrali depresso lamellaque erecto-crenulata multispiratum, inferne processu centrali styliformi paucispirato praeditum, limbo peripherico incrassatum.- Animal hucusque incognitum.*

Hab. In fundis coralligenis maris Sardiniam meridionalem ambientis.

* 5, Triq ir-Rghajja, Rabat RBT 2486, Malta
** Agisilaou 37-39, Tzitzifies/Kallithea, 17674 Athens, Greece

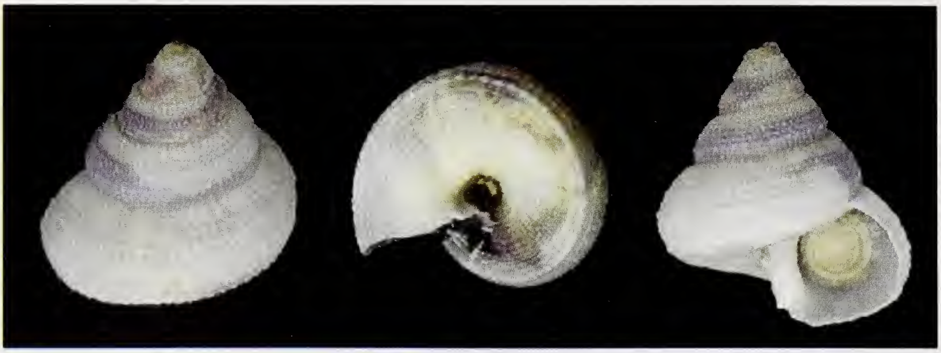

Figure 1. *Heliacus (Gyriscus) jeffreysianus* (Tiberi, 1867), off Crete Island on *Corallium rubrum* (Linnaeus, 1758) in 120m. Size: 9x8 mm. Photo P. Ovalis.
Figura 1. Heliacus (Gyriscus) jeffreysianus *(Tiberi, 1867), frente a la isla de Creta sobre* Corallium rubrum *(Linnaeus, 1758) en 120m. Size: 9x8 mm. Foto P. Ovalis.*

Tiberi dedicated his species to the illustrious malacologist John Gwyn Jeffreys (1809-1885). Two of the specimens are presently in the Coen collection at The Hebrew University, (Department of Zoology) Jerusalem, Israel and the other specimen is in the Jeffreys collection at the Smithsonian Institution, Washington (USA) (MELONE AND TAVIANI 1984).

New material: Two live specimens of *Heliacus* (*Gyriscus*) *jeffreysianus* were recently recovered from a living colony of *Corallium rubrum* (Linnaeus, 1758) from off the island of Crete at a depth of 120 m. Figure 1 shows one of the two similar specimens, measuring h= 9 mm x w= 8 mm which is about the same size as those found by Tiberi. The specimens were hand picked from a coral colony by a professional scuba diver from Crete using specialized diving equipment. It is not known whether the molluscs were actually feeding on the coral polyps. However, the species seems to have a close connection with *C. rubrum*. Several species from the family Architectonicidae are known to be parasitic on corals (BIELER 1993). Judging from the two presently known records, the species has always been found with these red corals, and as it is well known, it was never found in any other Mediterranean habitat notwithstanding the large amount of research carried out in the last hundred years.

Since its original description, the species had never been found again until recently, when living specimens of *Heliacus jeffreysianus* were collected in the Adriatic Sea (STANIC AND SCHIAPARELLI, 2007). It is very curious, but not surprising, that both this and our discoveries were recorded at the same time and at distantly separated places. This is certainly due to the more recent interest being undertaken both by amateur and professional researchers in the depths of the red and white coral substratum of the Mediterranean Sea. The authors are also aware of other unrecorded species living in this part of the Mediterranean, and originally described from deep water in the Atlantic.

Otherwise, *Heliacus jeffreysianus* has only been cited in the literature in a few species lists and catalogues pertaining to the Mediterranean malacofauna and it was even thought to be extinct. Moreover, no fossil specimens of the species have ever come to light (MELONE AND TAVIANI 1984).

MONTEROSATO (1880) had commented about the species of Tiberi "Il *G. jeffreysianus*, è una delle nostre più rare gemme, la cui scoperta, come di tante altre rarità coralligene, si deve al Dr. Tiberi. Soltanto tre esemplari ne sono conosciuti sinora. *Beati possidentes!* Io voglio ammettere che nella mente di un naturalista il *Gyriscus* abbia più valore

Figure 2. Map of the Mediterranean showing the three locations cited for *H. jeffreysianus*. 1: Sardinia Island; 2: Adriatic Sea; 3: Crete Island.
Figura 2. Mapa del Mediterráneo mostrando las tres localidades citadas para H. jeffreysianus. *1: isla de Cerdeña; 2: mar Adriático; 3: isla de Creta.*

del più grosso diamente della corona d'Inghilterra, ma francamente il prezzo al quale lo vende il Dr. Tiberi, per una conchiglia cosi piccola, sarà riguardato tanto dai naturalisti quanto dai mercanti come assai esagerato"

In translation: "The *G. jeffreysianus* is one of our most rare gems, its discovery, like many other coralligeneous rarities, is owed to Dr. Tiberi. Only thee specimens are known up to now. *Blessed are the possessors*! I must admit that in the minds of the naturalist the *Gyriscus* has more value than the largest diamond from the British crown, but frankly the price which Dr. Tiberi has asked, for such a small shell is regarded by naturalists and also by merchants as being exaggerated."

H. jeffreysianus is one of the most beautiful species from the family Architectonicidae. Its sculpture of small-beaded spiral chords and its trochoid shape make it outstanding and very distinguished among the other species of the family in the Mediterranean. In fact, Tiberi (1867) created a genus for it, *Gyriscus*, which is nowadays a subgenus of *Heliacus*. A very similar Pacific species is *H.* (*Gyriscus*) *asteleformis* (Powell, 1965) from New Zealand.

COEN (1932) figured the operculum from one of the two specimens in his collection (also figured in MELONE AND TAVIANI, 1984). MELONE AND TAVIANI (1984) described and figured a syntype from the Coen collection. They also figured the radula (as redrawn after MERRIL, 1970). Other descriptions and diagnoses of the genus and the species can also be found in COEN (1932), MELONE AND TAVIANI (1984) and in BIELER (1993).

CONCLUSIONS

This very long elapsed period of over 140 years for the re-discovery for *H. jeffreysianus* is in all probability due to its rarity and the very particularly restricted and difficult to sample habitat. Red coral was traditionally harvested by fishermen utilizing a particular gear called the Cross, which consists of two large beams tied together in the form of a cross and armed with dangling ropes and pieces of netting to enable the coral to entangle during dredging. This heavy equipment, although it seemed adequate for the purpose, besides being very destructive to the substratum, constantly shakes the entangled corals and the molluscs seem to always fall off before the gear is brought aboard the vessel. The modern method of manual harvesting through SCUBA is more selective, and therefore much less destructive. However, it is much more risky and dangerous.

Curiously, this species had not been discovered on red coral before, although

the method of manual harvesting of coral by specialized deep diving equipment (using a mixture of gases) has now been in practice for many years, especially by Spanish, Italian and Greek coral divers. More probably, it may take the keen eyes of a biologist, a naturalist or a shell collector to notice and pick out the small mollusc shells in situ. Therefore any specimens brought up by chance by the fishermen or the divers are probably either thrown back into the sea with the other rubbish as in the case of the fishermen or in the case of the diver, they fall off the coral unnoticed during the long decompression process. Moreover, the diver would be even more concerned for his "treasure" rather than a few "worthless" shells. Although Mediterranean *Corallium rubrum* is also found at great depths in the Mediterranean, the two existing records of *H. jeffreysianus* are both from shallow water living colonies. Stanic and Schiaparelli (2007) did not mention the species on which they found their specimens. Finally, this record extends the species distribution to quite a larger area of the Mediterranean (Fig. 2) and it is expected that more specimens which could contribute to the study of the biology of the species are likely to turn up.

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We would like to thank Agios Nicolaos, a specialized deep sea coral diver for donating one of the two specimens which he collected to one of the authors (P. O.) for this study. Thanks are also due to Sophie Valtat (Belgium) for providing important literature and to S. Gofas (Spain) for revising and enhancing the manuscript.

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Notes on West African *Perrona* (Gastropoda: Clavatulidae), with the description of a new species

Notas sobre *Perrona* (Gastropoda: Clavatulidae) en Africa Occidental, con la descripción de una nueva especie

Emilio ROLÁN*, Peter RYALL** and Juan HORRO***

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ABSTRACT

The type species of the genus *Perrona* is poorly known and given an erroneous type locality. One of the purposes of this paper is to clarify its status and correct spelling as well as illustrating the species and defining its distribution area. A new species from Angola belonging to this genus is described. The shell, protoconch, operculum and radula are illustrated, and the reasons for assigning this new species to this genus are discussed. All known species of *Perrona* are figured.

RESUMEN

La especie tipo del género *Perrona* es poco conocida y la localidad tipo dada es errónea. El objetivo de este trabajo es clarificar su situación, su correcto nombre, además de representar la especie y clarificar su área de distribución. Se describe una nueva especie de este género de Angola. Se muestran concha, protoconcha, opérculo y rádula de la nueva especie y se discuten las razones para asignarla a este género y no a otros con similar morfología. Se ilustran todas las especies conocidas de este género.

KEY WORDS: Clavatulidae, *Perrona*, West Africa, Angola, new species.
PALABRAS CLAVE: Clavatulidae, *Perrona*, África occidental, Angola, nueva especie.

INTRODUCTION

Classical malacological works like Bruguière (1792), Lamarck (1801, 1816 and 1822), Kiener (1840) and Reeve (1843, 1845) and publications dealing with Turridae (s.l.) such as Récluz (1851), Petit de la Saussaye (1851), von Maltzan (1883, 1884), Sykes (1905), Dautzenberg (1912), Strebel (1912, 1914) have described numerous West African species assigned to the family Clavatulidae Gray, 1853.

Their generic placements and synonymies are still not clear. Some modern works like Knudsen (1952, 1956), Ardovini (2004), Boyer and Hernandez (2004), Nolf (2006), Nolf and Verstraeten (2006) and Boyer and Ryall (2006) have described new species or revised others, placing most of them in the genus *Clavatula*.

Among our material from Angola, dredged over many years by Xico Fer-

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** St. Ulrich 16, A-9161 Maria Rain, Austria
*** Montero Ríos, 30-3º 36201 Vigo, Spain

nandes, a new small unidentified species was found. Its description is one of the subjects of this work. The generic attribution to the genus *Perrona* (Schumacher, 1817) requires a review of the type species because it is a rather poorly known species. This paper therefore also comments on the type species.

The identity of *Perrona perron*

MARTINI AND CHEMNITZ (1788: 278, pl. 164, figs. 1573, 1574) illustrated a shell they named *"Der Perron"*. Later GMELIN (1791), referring to Chemnitz´s figures, described it as *Murex perron* and indicated "in Oceano australi" as its geographic origin. This type locality is obviously wrong. These figures, or the shell they represent, can be considered to be the lectotype. Its present whereabouts, as noted below, are unknown.

When LAMARCK (1816) described *Pleurotoma spirata* he also made reference to the same illustrations, but separated his species from them by stating *"La figure citée de Chemnitz offre sur la base du dernier tour, des sillons dont notre coquille est absolutement dèpourvue"*.

SCHUMACHER (1817) also referred to the same illustrations of Chemnitz when he described the genus *Perrona* and nominated *Perrona tritonium* as the type of this genus. *P. tritonium* is therefore a junior objective synonym of *Perrona perron* (Gmelin). Again no locality was given.

The species was subsequently described for a third time by REEVE (1843) who referred once more to Chemnitz's illustrations. He gave it the name *Pleurotoma perronii*, drawing his own figure from his own shell. He likewise did not state a locality or habitat. Reeve cited Lamarck´s *spirata* as a different species, writing *"I have a shell before me of very different character (*Pleurotoma Perronii, *nobis), answering exactly to the figure in question"*. REEVE (1843) did not cite Gmelin and therefore appeared to consider his name as a valid new species. However it is clearly a junior synonym of Gmelin's species and it is concluded that this was an omission in Reeve's work.

MARRAT (1877) was the first to give an indication of the true range of the species when he included it in a list of North-west African shells which he stated came "from Madeira to the Gulf of Guinea".

TRYON (1884), although stating his opinion that this species was an intermediate form between *lineata* and *spirata*, mentioned it as *Clavatula* (subgenus *Perrona*) *perron* Chemnitz and provided a detailed description.

STREBEL (1912), in his revision of genus *Perrona*, treated as clearly different species both *spirata* and *perron*. He was able to examine Chemnitz's specimen from which the famous drawings were made and reillustrated it. He referred immature specimens of the species to Reeve's description, calling them *perron var. reevei*. He also correctly indicated part of the correct habitat range of the species, citing specimens he had examined from Pointe Noire, Congo to Ambriz, northern Angola.

KNUDSEN (1952) employed the name *"Clavatula perronii (Reeve)"* noting that the *"Atlantide* expedition" could not obtain any additional material and that Chemnitz´s type could no longer be traced at the ZMUC.

POWELL (1966), who referred correctly to the type species of *Perrona*, did not figure *Perrona perron* but illustrated *Perrona spirata* (Lamarck, 1816).

More recently, CERNOHORSKY (1974) figured a syntype from Chemnitz (in ZMUC), commenting that *"the species most probably lives in West Africa but this locality has been not substantiated by either literature records or authentic specimens. Another possibility is that* Murex perron *is conspecific with* Pleurotoma spirata *Lamarck, 1816, as suggested by NORDSIECK (1968: 154) although the two species appear quite distinct"*.

Finally, BERNARD (1984, fig. 182) figured under the erroneous name *"Clavatula kraepelini"* three specimens of this species. He unknowingly extended Strebel's habitat range northwards, quoting the localities of both Cape Esterias and Mayumba in Gabon, and indicating a depth of -20 to -50 meters.

After examining Reeve's type specimen, the available literature and some

shells in the collection of one of the authors (PR), it was decided to record some additional information about this poorly known group.

Abbreviations:

AMNH American Museum of Natural History, New York
ANSP Academy of Natural Sciences, Philadelphia
BMNH The Natural History Museum, London
MCZ Museum of Comparative Zoology, Harvard university
MHNS Museo de Historia Natural "Luis Iglesias" Universidad, Santiago de Compostela
MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Muséum national d'Histoire naturelle, Paris
ZMUC Zoologisk Museum, Copenhagen
USNM National Museum of Natural History, Washington
ZSM Zoological Staatmuenchen Museum, Muenchen
CJH collection of Juan Horro, Vigo
CPR collection of Peter Ryall, Maria Rain

SYSTEMATIC PART

Family CLAVATULIDAE Gray, 1853
Genus *Perrona* Schumacher, 1817

Type species: *Perrona tritonium* Schumacher, 1817 = *Murex perron* Gmelin, 1791 = *Pleurotoma perronii* Reeve, 1843.

Perrona perron (Gmelin, 1791) (Figs. 1-13)

Der Perron Martini and Chemnitz, 1788: 278, pl. 164. figs. 1573, 1574 (Fig. 1).
Murex perron Gmelin, 1971: 3559.
Perrona tritonium Schumacher, 1817: 218.
Pleurotoma perronii Reeve, 1843: pl. 11, sp. 94 (Fig. 2).

Type material: Figured syntype of *Der Perron*, whereabouts presently unknown; this specimen is reported as examined by STREBEL (1912) but could not be traced by KNUDSEN (1952) who nevertheless mentions another shell labelled in the handwriting of Chemnitz. *Pleurotoma perronii*: holotype BMNH 1900.2.8.26.
Other material examined: 8 shells (Figs. 4-10), Pointe Noire, Congo (CPR).
Type locality: Erroneous for Der Perron (in Oceano australi). Not mentioned in the original description of any of the other taxa. Here designated at Pointe Noire, Congo.

Description: Shell (Figs. 3-12) see the original descriptions as well as TRYON (1884) and STREBEL (1912). The following data can be added: the protoconch (Fig. 13) consists of about 2 $^1/_2$ shiny, smooth whorls, honey brown in colour; the first whorl slightly darker and of 750 µm diameter. From the protoconch whorls a series of opisthocline axial ribs start to form, first as thin riblets extending from the top to the bottom of the whorl, becoming stronger and shaped as an inverted C in the second teleoconch whorl where their bases become more globose. Between them small striae can be seen. In the subsequent whorl they detach themselves entirely from the upper subsutural cord which also increases in prominence. In the fourth teleoconch whorl these vestiges of the axial ribs become closer and closer to the lower suture, declining in prominence until they entirely disappear. The following whorls are smooth with an irregular, raised subsutural collar and the whorls are traversed by s-shaped striae. At the same time as the axial riblets form in the third whorl,

about 9 radial striae also start to emerge becoming slightly stronger in the following whorls but then decreasing in intensity in the fourth or fifth whorls and thereafter are hardly noticeable.

The shell is a light honey-brown throughout. On the fourth whorl the subsutural colar starts to become lighter, being entirely white in the fifth whorl. In subsequent whorls it can be interrupted by patches of light brown; in the final whorl the two major cords are white interspaced with small brown patches the same colour as the whorl itself and the cords on the columnella are also white.

Size: the shell can reach up to 37.2 mm (BERNARD, 1984).

Remarks: The comparison of juvenile specimens of *P. perron* with species of the genus *Clavatula* (type species: *Clavatula coronata* Lamarck, 1801) show much similarity in the aspect of the opisthocline axial ribs, which tend to disappear with maturity in the subsequent whorls. For this reason it is concluded that there is a stronger relationship between these two genera, than with other genera within this family.

Whilst some authors synonymized *P. perron* with *P. spirata* Lamarck, 1816 it must be noted that not only are they morphologically different, but the latter inhabits an area further to the south, being restricted to the Luanda area where it has been found at -5/50 meters.

Distribution: This species inhabits the West African infralittoral coast from Cap Esterias (Gabon) to Ambriz (northern Angola).

Special remarks: The type locality is always related with a holotype or a lectotype. In the present case, the original figures are sufficient to determine the identity of the species and it is not necessary to designate a neotype; *Pleurotoma perronii* was described lacking type locality as confirmed by the label of this holotype in BMNH. If the type locality of the first description is erroneous, and no other is mentioned in the description of the synonymized taxa, it is necessary to give more detailed information. Pointe Noire (Congo) is designated as the type locality being in the center of the known distribution area, as well as a locality mentioned by STREBEL (1912) and the source of our specimens. Our material agrees very well with the figures and the known holotype.

Concerning the correct spelling for the name of this species, it must be *perron*, which is the first name employed by GMELIN (1791) and which is apparently a name not dedicated to a person. TRYON (1884) stated that Chemnitz employed the common Dutch name "*perron*" (= flight of stairs, in reference to the profile) and that REEVE (1843), misinterpriting Chemnitz's name to be a personal name, Latinized it to read "*perronii*".

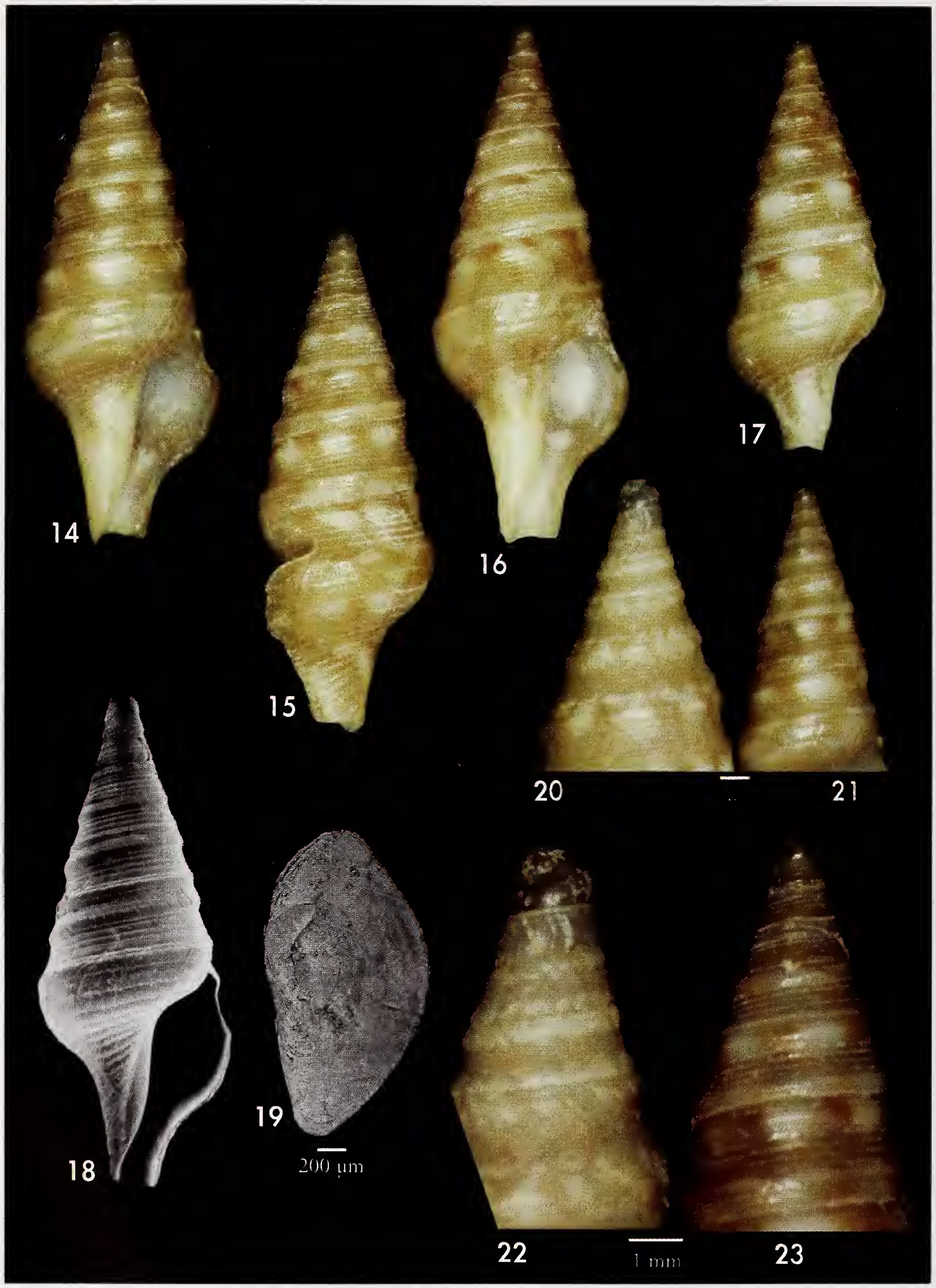
Perrona micro spec. nov. (Figs. 14-19, 21, 23, 24-28)

Material examined: Holotype (Figs. 14, 15), in MNCN (15.05/47050). Paratypes in the following collections: MNHN (1, Fig. 16); BMNH (1, Fig. 17); AMNH (1); USNM (1); ZSM (1); ANSP (1); MCZ (1); CPR (11); CJH (6); MHNS (16, Fig. 18).
Type locality: Palmeirinhas, south of Luanda, Angola, between 3 and 20 meters depth.
Etymology: The specific name refers to the small size of the species.

Description: Shell (Figs. 14-18) small for the genus, very solid, lanceolate. Protoconch (Figs. 21, 23, 24-26) with a little more than one whorl, of 530 µm in diameter and white in colour. The teleoconch begins with three grooves that separate 4 cords, later increasing to four and then five spiral grooves; there are six in the subsequent whorl; the two cords immediately below the suture as well as the lowest cord are more prominent. This gives the middle part of the whorl a concave appearance whilst the upper and lower parts protrude before their separation at the suture. There is no axial sculpture except for growth

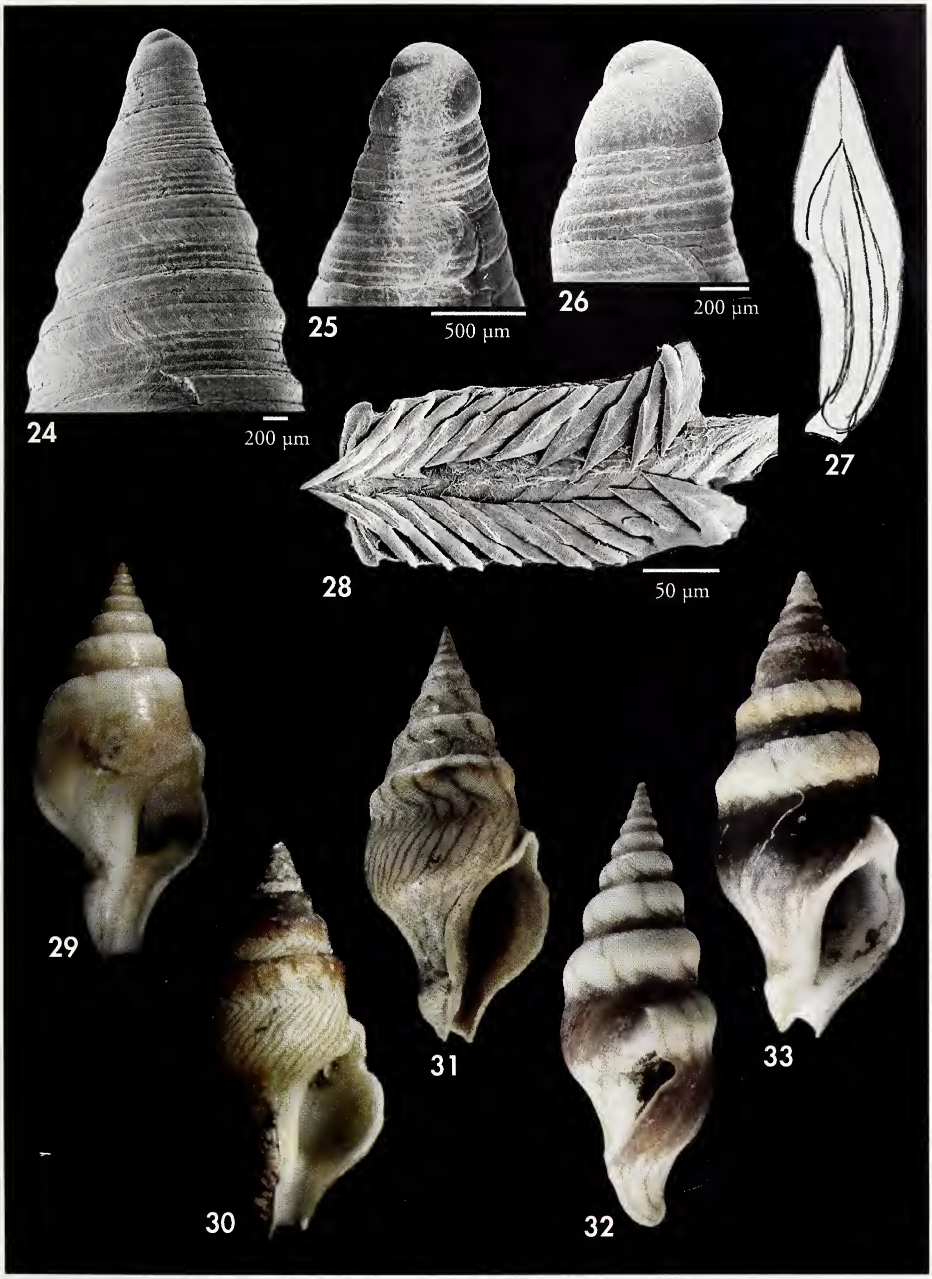
Figures 1-13. *Perrona perron*. 1: figure from MARTINI AND CHEMNITZ (1788); 2: figure of the holotype of *Pleurotoma perronii* from REEVE (1843); 3: holotype (see below Figs. 11, 12) of *Pleurotoma perronii* (BMNH) at the same comparative size; 4-6: shell (27.6 mm), Pointe Noire, Congo (CPR); 7: shell, 28.6 mm, Pointe Noire (CPR); 8, 9: juveniles, 18.6 and 14.2 mm, Pointe Noire (CPR); 10: shell, 27.2 mm, Pointe Noire (CPR); 11, 12: holotype of *P. perronii*, 25 mm (BMNH); 13: spire and protoconch, Pointe Noire (CPR).

Figuras 1-13. Perrona perron. *1: figura de MARTINI Y CHEMNITZ (1788); 2: figura del holotipo de* Pleurotoma perronii, *de REEVE (1843); 3: holotype (véase abajo Figs. 11, 12) de* Pleurotoma perronii *(BMNH) con el mismo tamaño relativo; 4-6: concha, 27,6 mm, Pointe Noire, Congo (CPR); 7: concha, 28,6 mm, Pointe Noire (CPR); 8, 9: juveniles, 18,6 y 14,2 mm, Pointe Noire (CPR); 10: concha, 27,2 mm, Pointe Noire (CPR); 11, 12: holotipo de* P. perronii, *25 mm (BMNH); 13: spire and protoconch, Pointe Noire (CPR).*



Figures 14-19. *Perrona micro* spec. nov. 14, 15: holotype, 10.3 mm (MNCN); 16: paratype, 10.6 mm (MNHN); 17: paratype, 8.5 mm (BMNH); 18: paratype, 7.6 mm (scanning electron microscope) (MHNS); 19: operculum (SEM). Figures 20-23. Comparison of the spire and protoconch of *Clavatula quinteni* (Figs. 20, 22) and *Perrona micro* (Figs. 21, 23).

Figuras 14-19. Perrona micro *spec. nov. 14, 15: holotipo, 10,3 mm (MNCN); 16: paratipo, 10,6 mm (MNHN); 17: paratipo, 8,5 mm (BMNH); 18: paratipo, 7,6 mm (microscopio electrónico de barrido) (MHNS); 19: opérculo (MEB). Figuras 20-23. Comparación de la espira y protoconcha de* Clavatula quinteni *(Figs. 20, 22) y* Perrona micro *(Figs. 21, 23).*



Figures 24-27. *Perrona micro.* 24: detail of the spire; 25, 26: detail of the protoconch; 27: radular tooth; 28: radula. Figures 29-33. *Perrona obesa.* 29: holotype, 34.0 mm (BMNH); 30: shell, 31.2 mm, 10 m, Namibe, Angola (CER); 31: shell, 35.7 mm, Namibe, Angola (CPR); 32, 33: shells, 40.2, 41.6 mm, Sacomar, Namibe, Angola (CPR).

Figuras 24-27. Perrona micro. *24: detalle de la espira; 25, 26: detalle de la protoconcha; 27: dientes de la rádula; 28: rádula. Figuras 29-33.* Perrona obesa. *29: holotipo, 34.0 mm (BMNH); 30: concha, 31,2 mm, 10 m, Namibe, Angola (CER); 31: concha, 35,7 mm, Namibe, Angola (CPR); 32, 33: conchas, 40.2, 41.6 mm, Sacomar, Namibe, Angola (CPR).*

lines which form an U-shape in the concave central portion; this is reversed on both the upper and lower protruding parts forming an overall S-shape on the whorl. There are about 6 whorls on the teleoconch, increasing gradually in width and height. The last whorl becomes elongated towards the base, the siphonal canal is widely open and almost similar in length to the lowest part of outer lip. The aperture is ovoid, with an U-shape sinus in the upper part, a sharp external lip, and a small callus on the columella. There are 20 spiral grooves from the periphery to the base. The colour is typically light brown or orangish, with white and dark blotches alternating on the subsutural cords, but in a few specimens the colour is darker and the white pattern is absent.

Soft parts: Study of a retracted specimen preserved in alcohol reveals a light coloured animal; the operculum (Fig. 19) is ovoid with the nucleus centrally placed on the interior. The radula (Fig. 28) is formed by two rows of about 70 elongate and sharply pointed marginal teeth (Fig. 27) at the center of which is a very small central tooth reduced to a cusp.

Dimensions: Holotype is 10.3 mm. The largest paratype is 12 mm.

Distribution: Only known from the type locality, where it is probably endemic.

Discussion: There is no known species from West Africa with which it can be confused. Only juvenile forms of *Clavatula quinteni* Nolf and Verstraeten, 2006, which are much larger when adult, are similar in profile and colouration; they both lack axial sculpture (see comparison in Figs. 20 and 21, 22 and 23) but *C. quinteni* has a much more elongated siphonal canal, a larger protoconch (more than double the diameter) and lacks spiral grooves.

There was some hesitation about the generic assignment of this new species. Comparison with morphologically similar species in some genera was made, in particular *Microdrillia* Casey, 1903; *Suavodrillia* Dall, 1918; *Parecuneus* Laseron, 1954, and *Maoritomella* Powell, 1942, *Tomopleura* Casey, 1904, and *Viriditurris* Powell, 1964. In all cases operculum and radula do not agree.

Perrona micro spec. nov., in spite of its small size, belongs to Clavatulidae. This is confirmed by the operculum with a medium-lateral nucleus and the wishbone-like marginal teeth with a vestigial rachidian one in the middle.

Powell (1966) reviewed the Turridae (s. l.) and defined the subfamily Clavatulinae H. and A. Adams, 1858 with four recent and two fossil genera; the recent genera being *Clionella, Clavatula, Perrona* (with subgenus *Tomellana)* and *Pusionella*. Kilburn (1985), who dealt only with South African species, noted 4 genera; *Toxiclionella, Benthoclionella, Clavatula* and *Clionella*. Tucker (2004) considers 492 fossil and 97 recent species in this group. Later Bouchet and Rocroi (2005) elevated Clavatulidae to family status.

The genus *Clavatula* Lamarck, 1801 is relatively abundant along the West Africa coast. Powell (1966) mentions 11 species. Most of them, including the type species (*Clavatula coronata* Lamarck, 1801) are of large size. Other species recently illustrated and/or described, as detailed in our introduction, are also relatively large. Although Boyer and Ryall (2006) noted that Knudsen (1952, 1956) classified other genera of *Clavatulidae* under the genus *Clavatula*, subsequent authors seem to ignore these genera and their paramaters as established by Kilburn (1985). A revision could conclude that some of them belong to other genera.

The genus *Clavatula* is described by Powell (1966): "shell moderately large to large sized, 15 – 55 mm, very solid, buccinoid, coarsely axially and spirally sculptured; with a tall, often coronated spire, and a truncate body-whorl, terminated in a relatively short reflected and deeply notched anterior canal.... Operculum ovate-lunate with a medio-lateral nucleus. Radula consisting of a pair of stout narrowly pointed marginal teeth of modified wishbone type, the proximal extremity separate and superimposed upon the larger element. A small

Figures 34-37. *Perrona spirata*. 34-36: shell covered by organic material, 31.5 mm, Luanda, Angola (CPR); 37: operculum. Figures 38-41. *Perrona subspirata*. 38: shell, 31.5 mm; 39-41: shell, 32.0 mm, Namibe, Angola (CPR); 42: operculum.

Figuras 34-37. Perrona spirata. *34-36: concha recubierta por material orgánico, 31,5 mm, Luanda, Angola (CPR); 37: opérculo. Figuras 38-41.* Perrona subspirata. *38: concha, 31,5 mm; 39-41: concha, 32,0 mm, Namibe, Angola (CPR); 42: opérculo.*

but well formed unicuspid central tooth is present also." According to KILBURN (1985) the main features of *Clavatula* are: deep anal sinus, realtively long siphonal canal, distict parietal tubercle and protoconch that is bluntly domed with about 2 1/2 whorls.

The species *P. micro* spec. nov. has some shell characters of *Clavatula* but has no axial sculpture and is smaller than all of them. *Clavatula cossignanii* Ardovini, 2004, the smallest Clavatulidae known in West Africa, is different in most features including the fewer number of protoconch whorls and is endemic to Senegal. The holotype is 13.2 mm but it can reach a size of 15.9 mm (CPR).

According to POWELL (1966) the genus *Clionella* Gray, 1847 differs from *Pusionella* Lamarck, 1801 by its claviform shape with tall, flat-sided spire whorls; simple long flexuous axials ribs without either subsutural or peripheral processes and a truncated body-whorl. KILBURN (1985) defines *Clionella* with an anal sinus; a slight notch; siphonal canal short with no distinct parietal tubercle; protoconch somewhat conical, of about 2 whorls, the first one rounded and tilted. The genus is usually restricted to South Africa. *P. micro* spec. nov. lacks axial sculpture, its sinus is deep and does not have a truncated body-whorl: therefore it does not agree with *Clionella*.

The new species was also ruled out of the genus *Pusionella* Gray 1847 because many specific characters are absent in *P. micro*; the flat-sided whorls; the outer lip bordered by a broad, subsutural, very slight sinus and the smooth and polished surface.

Finally, the genus *Perrona* Schumacher, 1817 is described by POWELL (1966) as: "shell moderately large, 25 – 40 mm, rather narrowly fusiform, with a tall spire of rapidly increasing whorls and a narrow body-whorl...surface smooth, or nearly so... with a conspicuous narrowly carinate subsutural collar....operculum as in *Clavatula*... radula with a pair of elongate marginals and a narrow-based unicusp central tooth."

The known West African species of *Perrona*, all figured in the plates in the present work, are the following: *P. perron* (Gmelin, 1791) (Figs. 1-13), *P. spirata* (Lamarck, 1816) (Figs. 34-37), both already mentioned, *P. obesa* (Reeve, 1843) (Figs. 29-33) and *P. subspirata* (von Martens, 1903) (Figs. 38-41), both endemic to South Angola. Other authors have placed other species in this genus, for example *Perrona nifat* (Bruguière, 1789) by ABBOTT AND DANCE (1986), but this generic placement is erroneous in our opinion. POWELL (1966) also mentions another West African species belonging to this genus but placed in the subgenus *Tomellana* Wenz, 1843: *Perrona (Tomellana) lineata* Lamarck, 1816; but this shell has a short, concave-outlined spire and a deep slit-like anal sinus and does not resemble our species. STREBEL (1912) referred other species to *Tomellana*; they also do not correspond with the species currently reviewed.

Perrona micro spec. nov. is more similar to *Perrona perron* than to any other type species and the new species is placed in this genus as being the closest. Also noticed is a similarity in the colouration of the subsutural cord as well as the S-shaped axial striae. We find this at present the better solution rather than to create a new genus.

Whilst the similarity noted with *Clavatula quinteni* should not create confusion, a result of this paper must also be to assign this species to the genus *Perrona* although this has not been the reason for this work.

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Pattern of reserve storage of the two mussel species *Perna perna* and *Mytilus galloprovincialis* living on Moroccan coasts: annual variation and effect of pollution

Patrones de almacenamiento de reservas en dos especies de mejillón *Perna perna* y *Mytilus galloprovincialis* de las costas de Marruecos: variación anual y efecto de la contaminación

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ABSTRACT

The pattern of reserve storage and its importance in the reproductive cycle of the two mussel species living in Moroccan coasts, *Perna perna* and *Mytilus galloprovincialis*, were studied comparatively, during two annual cycles. Study was conducted at a polluted and an unpolluted site in Agadir bay. Stereological analysis shows that *P. perna* presents only one type of storage cells (vesicular cells) storing glycogen. In *M. galloprovincialis*, two types of storage cells are present: vesicular cells and adipogranular cells (containing glycogen, lipids and proteins). In both species, seasonal variations of reserve tissue volume are conversely proportional to those of the germinal tissues. Reserve tissue appeared in spring (May) and increased in summer. It decreased quickly from August onwards, and disappeared between January and April. In *M. galloprovincialis*, adipogranular cells disappeared before vesicular cells and reappeared first. In the polluted site, seasonal variation of reserve and germinal tissues is comparable to that in unpolluted site but the maximum value of reserve tissue percentage is less important. Moreover, during the year, this tissue did not disappear. Biochemical analysis shows that mean values of glycogen and proteins quantities are significantly higher in *P. perna* than in *M. galloprovincialis.* However, total lipids quantity mean is higher in *M. galloprovincialis*. Seasonal variations of the three biochemical parameters present a similar profile in the two species. Compared to unpolluted site animals, in polluted one, molluscs possess low glycogen and high lipids levels. Seasonal variations of these parameters show a perturbed profile.

RESUMEN

Se ha estudiado y comparado el patrón de almacenamiento de reservas y su importancia en el ciclo reproductor en dos especies de mejillón de las costas de Marruecos, *Perna perna* y *Mytilus galloprovincialis*, durante dos ciclos anuales. Este estudio se llevó a cabo en un sitio contaminado y otro no contaminado de la bahía de Agadir. El análisis estereológico demostró que *P. perna* presenta un solo tipo de células de reserva (células vesiculares) almacenando glucógeno. En *M. galloprovincialis*, hay dos tipos de células de

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reserva: células vesiculares y células adipogranulares (conteniendo glucógeno, lípidos y proteínas). En ambas especies, las variaciones estacionales del volumen de tejido de reserva son inversamente proporcionales a las del tejido germinal. El tejido de reservas apareció en la primavera (mayo) y se incrementó en verano. A partir de agosto, disminuyó rápidamente y desapareció entre enero y abril. En *M. galloprovincialis*, las células adipogranulares desaparecieron antes que las células vesiculares y son las primeras en aparecer en el siguiente ciclo. En el sitio contaminado, la variación estacional de tejidos de reserva y germinales es similar a la del sitio no contaminado, salvo que el porcentaje máximo de tejido de reserva es menor. Además, este tejido no desapareció a lo largo del año. Los análisis bioquímicos muestran que las cantidades promedias de glucógeno y de proteínas son significativamente más altas en *P. perna* que en *M. galloprovincialis*. Sin embargo, el promedio de lipidos totales fue mayor en *M. galloprovincialis*. Las variaciones estacionales de los tres parámetros presentan un perfil similar en las dos especies. Comparados con los del sitio no contaminado, los animales del sitio contaminado poseen niveles bajos en glucógeno y altos en lípidos. Las variaciones estacionales de estos parámetros muestran un perfil perturbado.

KEY WORDS: Agadir, Morocco, mussels, *Mytilus galloprovincialis*, *Perna perna*, pollution effects, reproductive cycle, reserves strategy.

PALABRAS CLAVE: Agadir, Marruecos, mejillones, *Mytilus galloprovincialis, Perna perna*, efectos de la contaminación, ciclo reproductor, estrategias de reserva.

INTRODUCTION

Two sympatric mussel species are found along the Moroccan coast: the African mussel *Perna perna* and the Mediterranean mussel *Mytilus galloprovincialis*. The first species is located in the north of its geographical distribution; the second one in its southern limit. In Agadir bay, these local populations of mussels have important commercial values (Id Halla, 1997) and environmental interest (Najimi, Bouhaimi, Daubèze, Zekhnini, Pellerin, Narbonne, and Moukrim, 1997; Kaaya, Najimi, Ribera, Narbonne, and Moukrim, 1999; Moukrim, Kaaya, Najimi, Roméo, Gnassia-Barelli, and Narbonne, 2000) as sentinel species.

The few studies carried out on mussel biology in this area, concern only some aspects of the reproduction cycle (Shafee, 1989; Id Halla, Bouhaimi, Zekhnini, Narbonne, Mathieu, and Moukrim, 1997). They showed that *P. perna* and *M. galloprovincialis* present synchronous reproductive cycles, and breed throughout the year with a principal spawning period in spring. The only differences observed by Id Halla *et al.* (1997), regard the duration of the principal spawning period (more important for *P. perna*) and the genital activity rhythm in summer (reduced in this species).

In view of the importance of reserves in the reproductive cycle (Bayne, Bubel, Gabbott, Livingstone, Lowe and Moore, 1982; Lowe, Moore and Bayne, 1982; Pipe, 1987) and of the particularities of reserve strategy in *Mytilidae* (strategy essentially based on the glycogen, presence of specific storage cells and existence of a direct relationship between reserve metabolism and reproductive cycle), it was interesting to conduct a comparative study of *P. perna* and *M. galloprovincialis* in order to describe the reserves strategy for these two species living in the same environmental conditions. The two molluscs present an important difference regarding the cells involved in the reserve storage. As indicated by Lunetta (1969) *P. perna* presents only one type of storage cells (vesicular cells or glycogen cells), storing especially the glycogen ; however, in *M. galloprovin-*

cialis (HERLIN-HOUTTEVILLE, 1974; DANTON, KIYMOTO, KOMARU, WADA, AWAJI AND MATHIEU, 1996), two types of storage cells are present, vesicular cells (storing glycogen) and adipogranular cells (containing glycogen, lipids and proteins).

Furthermore, beyond the determination of pattern of reserve storage and its importance in the reproductive cycle of the two mussels living in Moroccan coasts, this work studies the impact of pollution on this pattern. Therefore, a comparative study of two sites (unpolluted and polluted) was conducted.

MATERIAL AND METHODS

Sampling

This study was conducted during two annual reproductive cycles (October 1994 to August 1996). Two types of sites, representative of the Agadir marine bay were considered: *i)* a reference site (unpolluted), Cap Ghir, located 50 km north of Agadir City and far from any human activity, and *ii)* a polluted site (Anza) located 5 km north of Agadir and receiving the industrial and domestic untreated waste waters of Anza zone. Many studies, conducted during the same period of the present study, showed that this site is contaminated by heavy metals and PAHs either accumulated by mussels or in sediment (ID HALLA, 1997; NAJIMI, 1997; MOUKRIM, KAAYA, NAJIMI, ROMÉO, GNASSIA-BARELLI AND NARBONNE 2000; KAAYA, 2002), with some perturbations in the physical and chemical parameters of seawater (ID HALLA, 1997).

During this study, for each month, ninety individuals of 35 mm for each species are collected at random in each of the two sites. 30 individuals/species/sites were subject to stereological analysis and 60 individuals/species/sites were dedicated to the biochemical analysis.

Stereological analysis

In order to follow the seasonal variation of the glycogen according the reproduction cycle in *Mytilus galloprovincialis* and *Perna perna*, an histochemical study (stereological analysis) was conducted in the mantle. Thirty adult mussels were collected and directly fixed in Gendre liquid for 3 days. Animals were then removed from shells and a central portion of mantle tissue was correctly excised and embedded in paraffin. Sections of 6 µm were cut and stained by the periodic acid of Schiff (PAS). Stereological analysis was applied according the method of WEIBEL, KISTLER, AND SCHERLE (1966) which quantified the volume occupied by the reserve and germinal tissues. The cell types were determined according the definition of LUBET (1959): *i)* adipogranular cells (20-25 µm for length, 4.5-5 µm for length of nucleus, green coloration, contain lipids, proteins and glycogen), and *ii)* vesicular cells (50-80 µm for length, 3-5 µm for length of nucleus, pink coloration, contain only glycogen)

Biochemical analysis

Biochemical analysis (glycogen, lipids and proteins) was carried out on mussel mantle which in Mytilidae, constitutes an important organ in storage of reserves. Monthly, sixty adults were randomly sampled, quickly transferred to the laboratory in isotherm conditions and frozen at -30°C. Glycogen, total lipids and proteins were respectively measured according the methods of DUCHATEAU AND FLORKIN (1959), FOLCH, LEES AND SLOANE-STANLEY (1957) and LOWRY (1951). Rates of these compounds were expressed as mg/g fresh weight (mg/g FW).

Statistical analysis

Stereological analysis was expressed as a percentage of the total volume of mantle tissue ; biochemical results as means ± standard deviations. The statistical significance of difference between samples was evaluated by the "t" test using the Statistica software (Release 4.5A Statsoft Inc. Ed. 1993). A "P" value of less than 0.05 was considered as statistically significant.

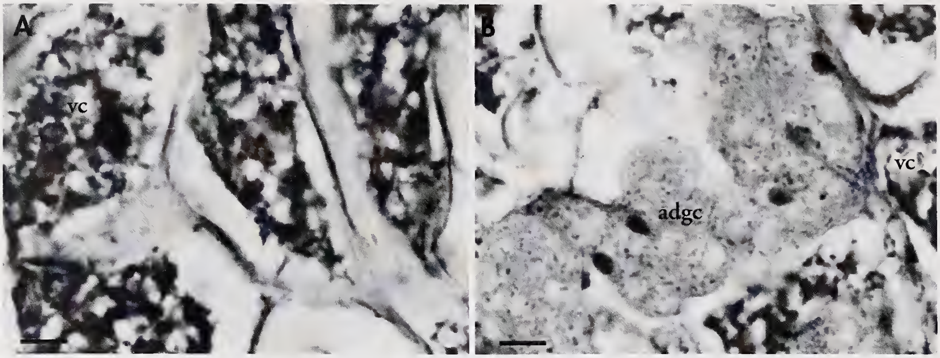

Figure 1. Cells implicated in the reserve storage in *Perna perna* (A) (only one type of cells: vc: vesicular cells) and *Mytilus galloprovincialis* (B) (two types of cells, vc: vesicular cells; adgc: adipogranular cells). Scale bars 10 µm.

Figura 1. Células implicadas en la acumulación de reservas en Perna perna *(A) (solo un tipo de células: vc: células vesiculares) y* Mytilus galloprovincialis *(B) (dos tipos de células, vc: células vesiculares; adgc: células adipogranulares). Escalas 10 µm.*

RESULTS

Stereological analysis

Figure 1A shows that the mantle of *Perna perna* presents only one type of storage cells: vesicular cells (VC). In *Mytilus galloprovincialis* (Fig. 1B), two types of storage cells are present: adipogranular cells (ADGC) and vesicular cells (VC).

For *P. perna*, the respective volumes of germinal and reserve tissues are conversely proportional (Fig. 2A). The seasonal profile is similar during the two studied annual cycles. The volume of germinal tissue increases from October to February, when the maximum is reached (respectively 72% and 77% in the first and second year). From March onwards, the germinal tissue volume decreases to reach the minimum in August (respectively 8% and 6% in the first and second year). The reserve tissues appeared in spring (May) and increased until reaching maximal values in summer (August). They decreased quickly and disappeared between January and April. In the polluted site (Fig. 3A), the seasonal variation of reserve and germinal tissues is similar to that in the reference site but the maximum value of reserve tissues percentage is lower (57% and 62% respectively in the first and second year). Moreover, during the year, this tissue did not disappear. The minimum value recorded was 7-10% in February.

For *Mytilus galloprovincialis* (Fig. 2B), the volume of germinal tissue increases in autumn and in the beginning of winter to reach a maximum in February (75%). Thereafter, we observe a reduction of the surface occupied by this tissue until October where the minimum (12%) is reached. During the second cycle a similar evolution is recorded. Otherwise, as with *P. perna*, the volume of germinal tissue is inversely proportional to reserve tissue. Nevertheless, in this case, the maximum is reached in October (64%), whereas the disappearance takes place from January to March for the two studied yearly cycles. In the polluted site (Fig. 3B), the reserve tissue presents a seasonal evolution similar to the reference site. Besides, this tissue never disappears as in *P. perna*. The occupied minimal volume is 5% reached in February.

Moreover, for *M. galloprovincialis*, in the reference site, the adipogranular cells disappeared before the vesicular cells and then reappeared first. In the polluted site the two cellular categories persist

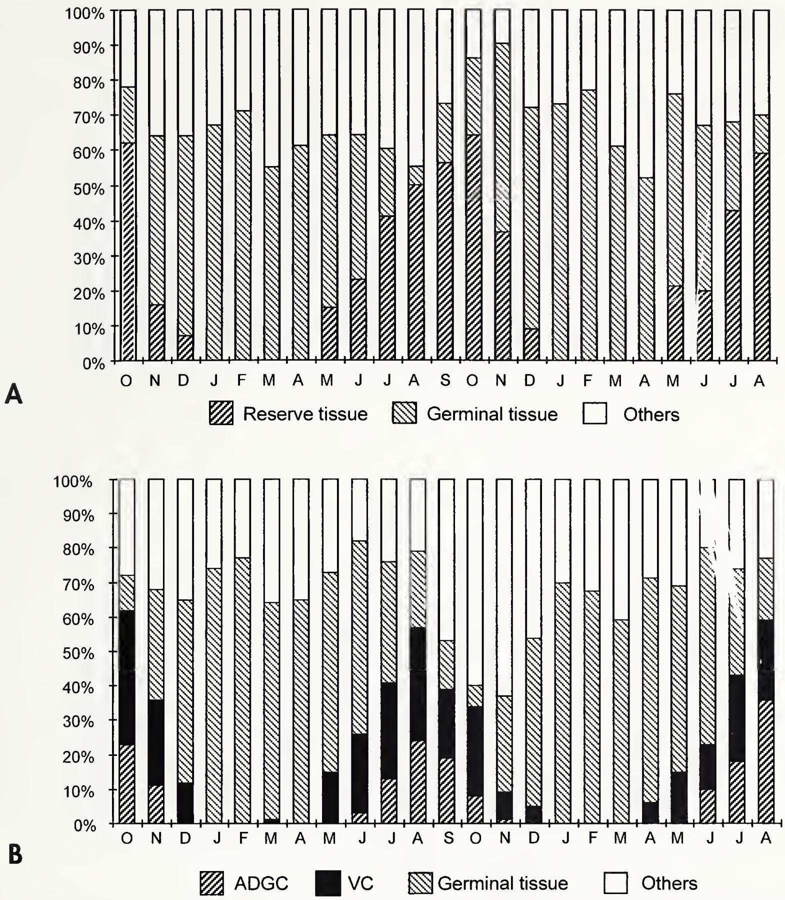

Figure 2. Seasonal variation of germinal and reserve tissues in *Perna perna* (A) and *Mytilus galloprovincialis* (B) in the unpolluted site. (VC: vesicular cells storing glycogen; ADGC: adipogranular cells, containing glycogen, lipids and proteins).

Figura 2. Variación estacional de los tejidos germinal y de reservas en Perna perna *(A) y* Mytilus galloprovincialis *(B) en el sitio no contaminado. (VC: células vesiculares almacenando glucógeno; ADGC: células adipogranulares, conteniendo glucógeno, lípidos y proteínas).*

during all the year. However, an oscillation can be observed in the volumes occupied by the two categories of cells.

Biochemical analysis

Glycogen: The mean amount of glycogen is significantly (F= 11.19 and P= 0.027) higher in *Perna perna* than in *Mytilus galloprovincialis* (respectively 59.6 ± 7.36 and 48.7 ± 4.78 mg/g FW). For the two species, the seasonal variations are significant (F= 4.95 ; P= 10^{-6} for *Perna perna* and F= 2.65 ; P= 4.7×10^{-6} for *Mytilus galloprovincialis*) and exhibit a similar profile (Fig. 4A). The glycogen increases in spring (from April), reaches a maximal value in August (219.4 and 191.9 mg/g FW in *Perna perna* and *Mytilus galloprovincialis* respectively), then decreases during autumn and winter. The minimal values are noted in February (0.39 and 0.34 mg/g FW in *Perna perna* and *Mytilus galloprovincialis* respectively).

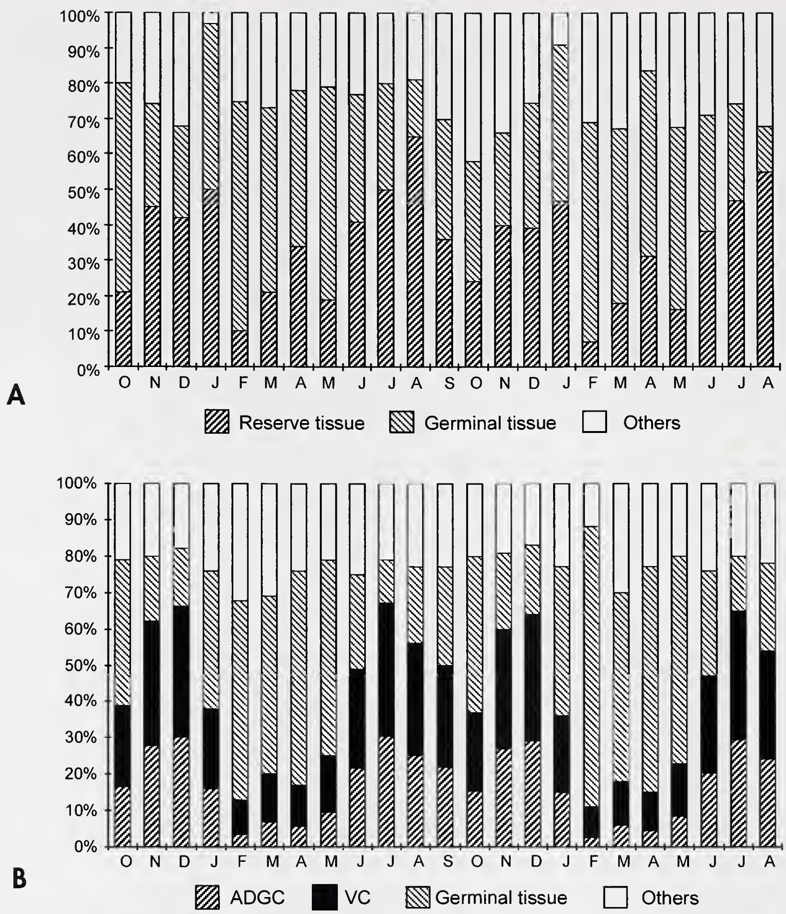

Figure 3. Seasonal variation of germinal and reserve tissues in *Perna perna* (A) and *Mytilus galloprovincialis* (B) in the polluted site. (VC: vesicular cells storing glycogen; ADGC: adipogranular cells, containing glycogen, lipids and proteins).

Figura 3. Variación estacional de los tejidos germinal y de reservas en Perna perna *(A) y* Mytilus galloprovincialis *(B) en el sitio contaminado. (VC: células vesiculares almacenando glucógeno; ADG: células adipogranulares, conteniendo glucógeno, lípidos y proteínas).*

In the polluted site (Fig. 4B), the difference between the mean amount of glycogen in the two species (39.75 and 23.44 mg/g FW in *P. perna* and *Mytilus galloprovincialis* respectively) is not significant (F= 6.257 and P= 0.130). Otherwise, their seasonal variation are significantly different (F= 4.03 and P= 10^{-6} in *P. perna* and F= 9.78 and P= 10^{-7} in *M. galloprovincialis*). The seasonal profile is completely different for the two molluscs: For *P. perna,* it presents three peaks, the first in June (96.05 mg/g FW), the second in November (118.87 mg/g FW) and the third in May of second year (159.02 mg/g FW). For *M. galloprovincialis*, only two peaks are recovered 65.03 and 153.64 mg/g FW respectively in May and November of the first year.

The comparison of values for reference and polluted site animals shows a significant difference. The values in the polluted site are less important (39.8 ± 13.36 instead of 59.6 ± 7.36 mg/g FW in

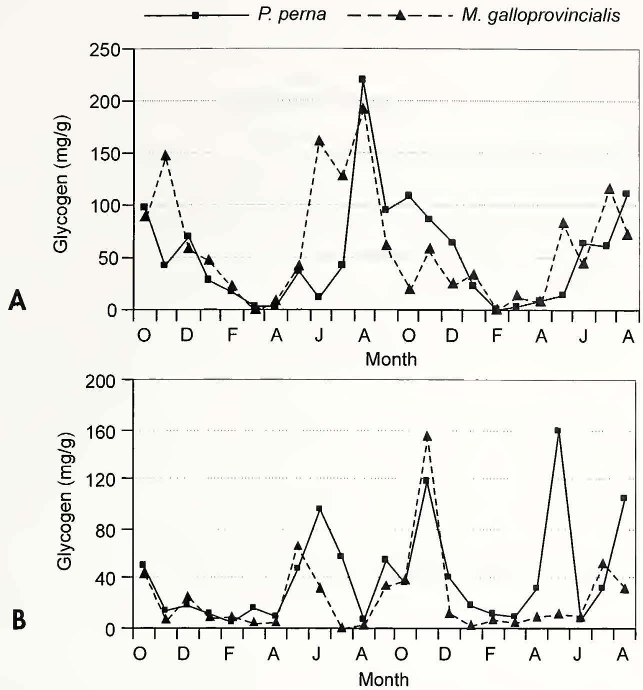

Figure 4. Seasonal variation of glycogen in the mantle of *Perna perna* and *Mytilus galloprovincialis* in the reference site (A) and the polluted site (B)
Figura 4. Variación estacional del glucógeno el el manto de Perna perna *y* Mytilus galloprovincialis *en el sitio de referencia (A) y en el sitio contaminado (B)*

the reference site, for *Perna perna*). Moreover, the seasonal profile of glycogen content (Fig. 4B) presents some perturbations compared to the reference site.

Lipids: A significant difference was noted between the mean amounts of total lipids in the two mussels species (92.86 and 125.04 mg/g FW in *P. perna* and *Mytilus galloprovincialis* respectively). However, the difference of their seasonal variation are significant with F= 4.42 and P= 10^{-6} in *P. perna* and F= 3.6 and P= $4.5\text{x}10^{-5}$ in *M. galloprovincialis*. In the first year, the seasonal profile (Fig. 5A) is similar for the two molluscs. The lipid content increased in autumn, with a maximal value in December (respectively 354.3 and 316.9 mg/g FW in *Perna perna* and *Mytilus galloprovincialis*), and decreased in winter and spring. However, in the second year, a slight increase was noted in summer (June - July) only in *P. perna*.

In the polluted site, the two species present a significant difference between total lipids mean values (respectively 231.4 ± 21.47 and 135.5 ± 16.93 mg/g FW in *Perna perna* and *Mytilus galloprovincialis*). Besides, the difference in their seasonal variation (Fig. 5B) is significant with F= 2.59 and P= 0.002 in *P. perna* and F= 3.60 and P= $4.5\text{x}10^{-4}$ in *M. galloprovincialis*.

Otherwise, the values are generally higher for the polluted site than the reference site for the two species. Moreover, compared to the unpolluted site, the seasonal variation (Fig. 5B) shows a perturbed profile with several peaks during the annual cycle and a maximum values is reached rather in August (777.03 mg/g FW in *P. perna* and 659.95 mg/g FW in *M. galloprovincialis*).

Proteins: The mean content of protein is significantly higher in *Perna perna* (28.9

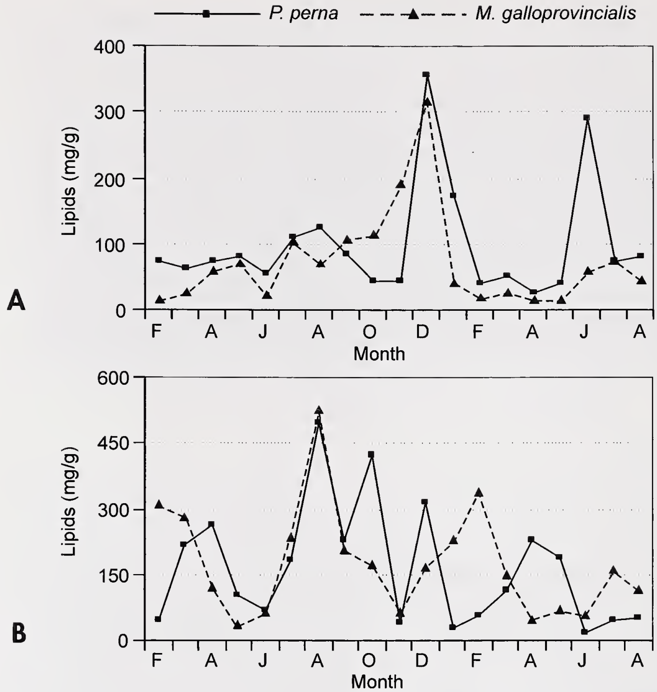

Figure 5. Seasonal variation of lipids in the mantle of *Perna perna* and *Mytilus galloprovincialis* in the reference site (A) and the polluted site (B).

Figura 5. Variación estacional de los lípidos en el manto de Perna perna *y* Mytilus galloprovincialis *en el sitio de referencia (A) y en el sitio contaminado (B).*

± 3.51 mg/g FW) compared to *Mytilus galloprovincialis* (20.2 ± 3.17 mg/g FW). However, the seasonal profile (Fig. 6A) is similar for the two species. The maximal values were generally recorded in summer and autumn in the first year and in winter and beginning spring in the second year, whereas the minimal values were reached at the end of autumn and the beginning of winter.

In the polluted site (Fig. 6B), the mean amount of protein is higher in *P. perna* (30.11 ± 7.742 mg/g FW) than in *M. galloprovincialis* (19.74 mg/g FW). However, the mean values and the seasonal profile do not show any significant difference compared with those observed from the reference site (F= 1.08 and P= 0.30 for *Perna perna*; F= 0.31 and P= 0.57 for *Mytilus galloprovincialis*). For the two species, the maximum values were recorded in summer and autumn.

DISCUSSION

The comparative study of the reserve pattern of the two mussels species living in the Moroccan coasts, *Perna perna* and *Mytilus galloprovincialis*, sampled in the same site (Cap Ghir, Agadir bay), shows that, in spite of the difference in their reserve tissues (only one cell type, vesicular cells, in *Perna perna* ; two cell types, adipogranular cells and vesicular cells, in *Mytilus galloprovincialis*), the two molluscs have a similar fluctuation.

This strategy presents cycles (of reserve compounds and cells involved in the storage) which, compared to the cycle of reproduction (determined in these same animals by ID HALLA ET AL., 1997) are inversely proportional to it. The accumulation of reserves in these cells is related to the period of reduced sexual

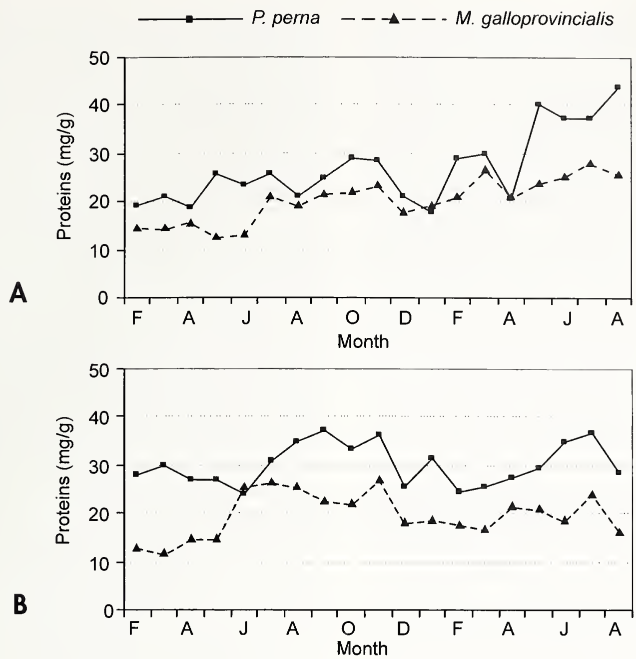

Figure 6. Seasonal variation of proteins in the mantle of *Perna perna* and *Mytilus galloprovincialis* in the reference site (A) and the polluted site (B).
Figura 6. Variación estacional de las proteínas el manto de Perna perna *y* Mytilus galloprovincialis *en el sitio de referencia (A) y en el sitio contaminado (B).*

activity (in summer). The low levels of reserve are obtained in autumn and particularly in winter (gametogenesis and spawning periods). Similar results have been reported in *Perna perna* from Brazilian coasts (LUNETTA, 1969) and in *Mytilus galloprovincialis* from the French coasts (HERLIN-HOUTTEVILLE, 1974; DANTON, KIYMOTO, KOMARU, WADA, AWAJI AND MATHIEU, 1996). Also, in the Ria de Vigo (Spain), the profile of the variations of the gonadic index and somatic index in cultured mussels show clearly their inverse and gradual fluctuations (CÁCERES-MARTÍNEZ AND FIGUERAS, 1998). This association between gonad and storage tissue cycles in mussels is well known. Decline of the ADG cells occurs during gametogenesis by a lysosomal autophagic mechanism (BAYNE *ET AL.*, 1982; LOWE, MOORE AND BAYNE; 1982; PIPE, 1987). The energy used in gonad restoration following spawning during spring and summer probably derived directly from feeding since ADG cells disappeared from the mantle in early spring (VILLALBA, 1995).

Furthermore, the reserve accumulation in the two mollusc species is related to the proliferation of the phytoplanctonic biomass linked to upwelling currents which take place, between February and August, in the Agadir bay and more precisely in Cap Ghir (BELVEZE, 1984 ; AGOUMI AND ORBI, 1992). CÁCERES-MARTÍNEZ AND FIGUERAS (1998) reported that this increase in food availability for mussels in the area favours the accumulation of reserves during this period. These results also confirm the close dependence, described by MATHIEU (1987), between the reserve storage and environmental conditions in marine ecosystems. As suggested by

this author, the disappearance of reserve tissue in mussels seems to be under endocrine control via cerebroid ganglia which provoke disappearance of adipogranular cells and vesicular cells in the mantle after liberation of their reserves which are indispensable for gametogenesis and spawning process. The synchronic character of this disappearance, in *Perna perna* and *Mytilus galloprovincialis*, could be explained by the existence of the same mechanism for the control of reserves in both species.

The comparison of the reserve compounds in the two molluscs shows that the glycogen, total lipids and proteins contents are higher in *Perna perna* (in spite of the presence of only one type of reserve storage cells, vesicular cells) compared to *Mytilus galloprovincialis*. These results could explain the differences observed by ID HALLA *ET AL*. (1997) between the reproductive cycles of these bivalves. According to these authors, in *Perna perna*, compared to *Mytilus galloprovincialis*, the main-spawning period in spring is longer and the sexual activity in summer is reduced. Otherwise, the important reserve levels in this species could be attributed to the spatial distribution of each species: *Perna perna* lives essentially at the infra-littoral level and is more immersed than *Mytilus galloprovincialis* (ID HALLA *ET AL*., 1997) and, consequently, has access to more nutrients, thus allowing the synthesis and storage of more reserves. SEED (1976) showed that the gonadal development was faster in mussels from the low intertidal zone, than in those from the upper zone and related these results to food availability. Other studies associated local variations in gonadal cycle with environmental conditions (FERRÁN, 1991; VILLALBA, 1995). According to CÁCERES-MARTÍNEZ AND FIGUERAS (1998), there is no influence of locality and depth in the gonadal development of cultured mussels.

The seasonal profile of the biochemical reserves studied shows that the first peak of glycogen and lipids, recorded in summer, is related to the occurrence of upwelling currents which provide food availability, ensuring an abundant planktonic food supply for mussels. According to CÁCERES-MARTÍNEZ AND FIGUERAS (1998), massive spawns occur in spring coinciding with an increase in temperature and chlorophyll-a concentration in the area providing favorable conditions for larval growth. In winter, the second peak of lipids coincides with the maturity period of gametes. This peak takes place just after the disappearance of the glycogen peak. It is probably a result of the glycogen transformation. The metabolic conversion of glycogen to lipids has been reported by Zaba and DAVIES (1980), using ^{14}C-glucose. According to GOSLING (1992), the mantle is considered as the organ of many and extensive metabolic transformations during the sexual cycle. The reserves, particularly the glycogen, accumulated during summer, are used in autumn and winter for the gametogenesis. Similar results were reported by SHAFEE (1989) in *Perna picta* of Temara (North of Morocco).

In the polluted site (Anza), many perturbations in the metabolism of reserves were noted comparatively to the reference site (Cap Ghir). The reserve tissues, which disappeared in winter and at the beginning of spring, in mussels of Cap Ghir, persist throughout the sexual cycle in Anza mussels. This could probably be a result of the pollution effect on the cerebroid ganglions neurosecretions which are, according to LUBET, HERLIN, MATHIEU, AND COLLIN (1976) and MATHIEU (1987) involved in the control of reserve cells.

The analysis of the seasonal profile of the reserve levels in mussels sampled in the polluted site shows some perturbations as compared to the reference site. For example, the glycogen content is low in summer (August), in spite of the availability of phytoplanctonic biomass in this period. This is probably linked to the stress caused by pollution of industrial and domestic waste waters discharged directly in this site, without any treatment. This fact was indicated by DESLOUS-PAOLI, WOLOWICZ, AND

BOROMTHANARAT (1991) who reported that, in *Mytilus edulis*, reserves could be used both in reproductive process and to overcome the hard environmental conditions. According to THOMPSON (1972) the reserves are used in order to reach the basal level of energy necessary for stressed animals.

Contrary to the glycogen, the total lipids are more important in *Perna perna* and *Mytilus galloprovincialis* living in Anza (polluted site). This could be explained by an eventual direct assimilation of lipids from the organic matter of waste waters and/or a change of the reserve storage process. According to GOSLING (1992) the lipid storage process in molluscs is considerably linked to the environmental conditions, particularly to the presence of pollutants.

As a general conclusion, in the two species of mussel *P. perna* (with only vesicular cells) and *M. galloprovincialis* (with adipogranular cells and vesicular cells), the respective germinal and reserve tissues clearly show their inverse and gradual profile. Their seasonal fluctuations are similar in the two molluscs. In the polluted site, many perturbations of the reserve metabolism were noted comparatively to the reference site. Then, contrary to animals of this latter site, which presented a glycogenic strategy, a lipidic strategy takes place in molluscs of the polluted site.

The results obtained in this work constitute a contribution to the knowledge of the reserve strategy in the two species living along Moroccan coasts, the African mussel *Perna perna* and the Mediterranean mussel *Mytilus galloprovincialis*. So, several facts are reported: i) the type, the seasonal variation and the cycle of the reserve strategy in the two molluscs, ii) cells involved in the storage, iii) the relationship between the reserve strategy and the reproduction cycle, and iv) the response of this strategy to the environmental conditions. Nevertheless, it would be interesting to identify the mechanism and the control process of the reserve strategy in these molluscs.

ACKNOWLEDGMENTS

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Reproduction of the cockle *Cerastoderma edule* (Linné, 1758) in the estuary of Oued Souss (southwestern Morocco)

Reproducción del berberecho *Cerastoderma edule* (Linné, 1758) en el estuario del Oued Souss (suroeste de Marruecos)

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ABSTRACT

Field and laboratory investigations were carried out from 2001 to 2003 on a population of *Cerastoderma edule* living in the estuary of Oued Souss, in order to determine the impact of domestic wastewater discharges on the biology of this species. During wastewater discharges, several episodes of partial spawning occurred from November to March, followed by another in April-May. The main spawning occurred nevertheless in August. The gonadic index was always higher than 1, so that the period of sexual rest was short. The period of recruitment (from June to October) was mainly correlated with spawning peaks. The renewal of the population was ensured by the recruitment of June-July, whereas young cockles recruited from August to October only represented 9.2% of the population at the end of autumn. Most 1-year-old cockles disappeared during the summer of the second year following their recruitment. After wastewater pollution stopped, an important recruitment of young cockles occurred. The spatial distribution of this species progressed upstream and the biomass of cockles had strongly increased. Because of its reproduction which takes place throughout the year, *C. edule,* as an opportunistic species, succeeded in colonizing this site.

RESUMEN

Se realizaron, entre 2001 y 2003, estudios de campo y de laboratorio sobre una población de *Cerastoderma edule* del estuario del Oued Souss, con el objetivo de determinar el impacto de los vertidos de aguas residuales sobre la biología de esta especie. Coincidiendo con los vertidos, se produjeron varios episodios de puesta parcial entre Noviembre y Marzo, seguidos de otro en Abril-Mayo. La puesta principal, sin embargo, se produjo en Agosto. El índice gonádico fue siempre superior a 1, indicando que el periodo de reposo sexual fue corto. El periodo de reclutamiento (de Junio a Octubre) estuvo esencialmente relacionado con picos de puesta. La reposición de la población fue asegurada por el reclutamiento de Junio-Julio, mientras berberechos jóvenes reclutados entre Agosto y Noviembre representaban tan solo el 9,2% de la población a finales de otoño. La mayor parte de los berberechos con un año de edad desaparecieron durante el verano del segundo año después de su reclutamiento. Al finalizar los vertidos se produjo un importante reclutamiento de berberechos jóvenes. La especie se extendió río arriba y la bio-

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masa de berberechos aumento fuertemente. Por su reproducción que se extiende sobre todo el año, *C. edule*, como especie oportunista, fue exitosa en la colonización de este lugar.

KEY WORDS: *Cerastoderma edule*, estuary, Oued Souss river, pollution, recruitment, reproductive cycle, wastewater discharges.
PALABRAS CLAVE: *Cerastoderma edule*, estuario, Oued Souss, contaminación, reclutamiento, ciclo reproductor,

INTRODUCTION

In marine environment, many biotic and abiotic factors may influence the life cycle of bivalves. If temperature, salinity, food supply, and tidal exposure are the most important causes known to modulate development in mytilids (SEED, 1975), other elements, such as intraspecific competition or environmental contaminants, can result in great variations in growth rate of bivalves (SEED AND SUCHANEK, 1992). These factors also have an effect on the reproduction, settlement, recruitment, and production of these molluscs so that their variations directly affect the development of beds for each species of bivalve (WIDDOWS AND DONKIN, 1992).

Contrary to numerous ecological reports on the effects of contaminants on different marine bivalves, the recovery of mollusc populations after the disappearance of pollution has been less investigated.

The implantation of a wastewater purification plant since November 2002 along the estuary of Oued Souss, at 4 km from the mouth of the estuary, had resulted in the fact that the fresh water still running in the river and the decanted wastewater were no longer discharged in the estuary but diverted to another coastal site: M'Zar, located at 3 km south. For this reason, the estuary, upstream to the purification plant, was only swept by sea tide at the present time.

As there existed a population of *Cerastoderma edule* living in the estuary of the Oued Souss river, it was interesting to determine the physiological state of these cockles during the pollution period by wastewater and the changes which have occurred after this contamination stopped. In view of these objectives, the following two questions arose: Had the discharge of wastewater before November 2002 caused repercussions on the reproductive cycle of *C. edule* and on the dynamics of this population? What consequences did the presence of sea water in the estuary after November 2002 have on the spatial distribution and biomass of *C. edule*? To answer the first question, monthly investigations from January 2001 to December 2002 were carried out in the habitat of *C. edule* i) to follow the different stages of sexual maturity in males and females, and ii) to specify the development of the different generations and cohorts of cockles. To tackle the second question, two surveys in 2002 and 2003 during summer months were performed in the estuary of Oued Souss river.

This study complements other reports made by our research team in the same ecosystem (MOUNEYRAC, PELLERIN, MOUKRIM, AIT ALLA, DUROU AND VIAULT, 2005; AIT ALLA, MOUNEYRAC, DUROU, MOUKRIM AND PELLERIN, 2005; AIT ALLA, GILLET, DEUTSCH, MOUKRIM AND BERGAYOU, 2005; BERGAYOU AND MOUKRIM, 2003 and GILLET, GORMAN, TALLEC, MOUKRIM, MOULOUD, ANAJJAR, AIT ALLA, BERGAYOU AND KAAYA, 2003).

MATERIALS AND METHODS

The estuary of Oued Souss is located on the Atlantic coast, in southwestern Morocco and is subjected to an arid climate. The mouth is swept by an intense marine hydrodynamism, responsible of the presence of great

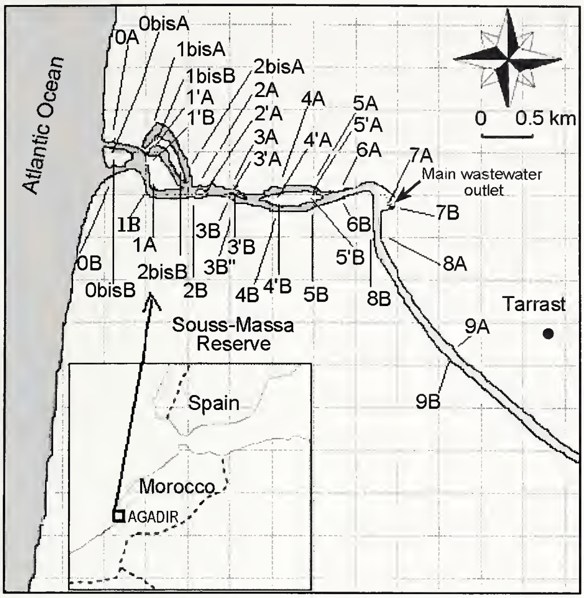

Figure 1. Location of sampling sites along the estuary of Oued Souss in the Bay of Agadir, southwestern Morocco.
Figura 1. Situación de las localidades de muestreo a lo largo del estuario del Oued Souss, en la bahía de Agadir, suroeste de Marruecos.

sandbanks in the estuary, with currents linked to high or low tides, and with high salinity (from 31.2 to 34.2‰).

Reproductive cycle

The study of reproductive cycle and population dynamics for *C. edule* were carried out at station 2 (30° 21.97′N north, 9° 35.98′W west), (Fig. 1). Selected because of its high biomass of the cockle population, this station was characterized by fine silty sand 2-5% of organic matter in the substratum and 340-440 mg/l of suspended matter in the water.

Two methods for studying the reproductive cycle of *C. edule* were used. The first was a classical histological study of gonads and was performed from January 2001 to March 2002. The second was a complementary study of condition index and microscopic examination of gonad smears (GUILLOU, BACHELET, AND GLÉMAREC, 1991) and was performed from August 2001 to August 2002. For the first and second study, respectively, 30 and 100 cockles (length, 20 to 30 mm) were collected by hand at low tide, at monthly intervals (respectively, a total of about 450 and 1300 accumulated cockles was examined).

For the first study (histological study of gonads), the shells of *C. edule* were opened and soft masses were prefixed in the Gendre's fixative for 24 h. In the laboratory, the shell of each bivalve was removed and small pieces of soft masses were post-fixed in a new solution of Gendre's fixative for 48 h before being dehydrated through a graded series of ethanol and butanol, and finally embedded in cytoparaffin (56°-58°C). Serial sections (thickness, 5 µm) were made before being stained with Gabe's trichrome, hemalun-eosin, or Mann-Dominici's method (GABE, 1968). The maturity of gonads was determined using the scale proposed by Lubet (1959) for *Mytilus edulis* (Table I).

The gonadic index (SEED, 1975) indicates the state of gonad maturity for

Table I. Terminology used by LUBET (1959) and LUCAS (1965) to study morphologically and histologically the gonadic developmental stages in bivalves.
Tabla I. Terminología empleada por LUBET (1959) y LUCAS (1965) para el estudio morfológico y histológico de estadios de desarrollo gonadal en bivalvos.

LUBET's scale (1959)	LUCAS's scale (1965)
Stage 0: sexual rest. Stage I: early gametogenesis with numerous goniae. Stage III D: spent, completely empty lumina.	Stage A: sex undetectable. This stage can correspond to sexual rest, previtellogenesis, or gamete resorption.
Stage II: actively developing gonads but mature gametes were not observed.	Stage B: sex detectable with difficulty to the naked eye.
Stage IIIA: near ripe follicles with mature gametes. Stage IIIB: spawning, follicles distended.	Stage C: identifiable gonad. The foot is salmon-stained in males and pearly white in females. Gonad maturation and spawning occurred during this stage.
Stage IIIC: partial spawning, partially empty lumina.	Stage D: gonadic reconstitution with co-existence of empty follicles and of tubules showing numerous goniae.

each population and is evaluated from histological slides. It was determined by giving a number to each of Lubet's gametogenic stages: stage 0 (number 1), stages I and II (2), stage IIIA (3), stages IIIB and IIIC (2), and stage IIID (1). For each sample of cockles, the number of gonads showing a gametogenic stage is multiplied by the corresponding number; the figures obtained were then added and the sum was then divided by the total number of cockles studied. This gonad index varied from 1 (all gonads were spent, with completely empty lumina) to 3 (all gonads were ripe).

The stereological analysis was made on the whole bivalves used for the histological examinations of gonads. For each *C. edule*, three histological slides were randomly chosen through the anteroposterior axis. The different cell categories present in gonadic follicles were counted on five ocular fields (magnification: x 100 for females, and x 400 for males) randomly selected in the visceral mass. In females, four categories: oogoniae, vitellogenic oocytes, ripe oocytes, and atresic oocytes, were considered. In males, the cells were classified into the following three categories: protogoniae and spermatogoniae, primary and secondary spermatocytes, and, lastly, spermatids and spermatozoa. The mean percentage of each cell category was calculated in relation to the total number of cells counted. Mean values and corresponding S.D. were established for each cell category.

For the second study, gonad smears and the determination of sex ratios were made by removing each bivalve from its shell and by rubbing soft masses against a histological slide. The microscopic examination was made using the scale of LUCAS (1965) adapted for *C. edule* by FERNANDEZ-CASTRO, GUILLOU, LE PENNEC, AND CARDENAS LOPEZ (1989) (see table I). The sex ratio (number of females in relation with the total number of bivalvs with a recognizable sex) was performed when this identification was easy. A χ^2 test was used to determine levels of statistical significance.

The condition index represents the variations of dry weight for a standard bivalve and aims to eliminate the effect of mollusc growth while revealing an accumulation or a loss of organic matter, associated with reproduction. A single

size class (20-30 mm) was considered and 30 bivalves were randomly chosen to determine this condition index. The index selected was that proposed by LUCAS AND BENINGER (1985): IC = [(dry weight of soft masses) / (dry weight of valves) x 1000]. The dry weight was obtained using a dehydration of soft masses (or shell) in a desiccator (60°C, 24 h).

Population dynamics

To study the dynamics of the population and to specify the period of juvenile recruitment, samplings of *C. edule* were performed from January to December 2002. This study was also carried out in the station 2. Monthly, sixteen sediment samples (surface, 0.0625 m^2, height, 20 cm) were collected at low tide according to the method of quadrats used by ELLIOTT AND DECAMPS (1973, in BAYED, 1982). These samples were sieved (square meshes, 1 mm) to recover and count cockles. The antero-posterior length of each cockle was measured using a calliper rule (precision, 0.1 mm). For mollusc sizes less than 5 mm, a stereomicroscope equipped with a micrometric ocular was used. The individual values recorded for the length of bivalves and sampling dates were compared using the FISAT software (GAYANILO, SPARKE AND PAULY, 1996) to draw size histograms in relation to the frequency of animals and to make a modal analysis based on the algorithm according to the method by Battacharya (1967). This comparison, with the use of the χ^2 test (at $P<0.05$) allows to distinguish the different size classes in each monthly sample, to determine mollusc densities, and to specify recruitment periods.

Spatial distribution, density and biomass

To determine the spatial distribution, density, and biomass (ash-free dry weight, AFDW) of cockles, two surveys were carried out in 2002 and 2003 (during summer period). The replication of this study during these two periods (in 2002, when the estuary received the wastewater, and in 2003, when the discharge stopped) gives insights on the wastewater pollution impact and the reestablishment of the ecosystem when this pollution stopped. These investigations were made in a total of 8 stations (27 sampling sites) located at 400-500 m intervals from the estuary mouth up to the wastewater outlet (Fig. 1). In each site, four to six sediment samples (surface, 0.0625 m^2, height, 20 cm) were collected at low tide according to the method of quadrats used by ELLIOTT AND DECAMPS (1973, in BAYED, 1982). These samples were sieved (square meshes, 1 mm) to recuperate and count cockles, as above.

Ash-free dry weight (AFDW) was determined by dipping molluscs in a solution of 10% HCl until the shell was completely dissolved. Then, the soft parts were dried for 48 h at 80°C, weighed, placed at 600°C for 2 h and weighed again. The weight loss at 600°C was considered to represent the AFDW of individuals and was expressed in g/m^2 (BACHELET, BOUCHET AND LISSALDE, 1980-1981).

RESULTS

Effects of pollution on the biology of the species

Reproductive cycle: The study of gonad smears from August 2001 to August 2002 had allowed to recognize sex in 1138 bivalves (87.5%). Within this group, the sex ratio of *C. edule* was 51.1% ± 2.6%, and was well-balanced at 1:1 ($\chi^2 = 2.5$, $P < 0.05$). No hermaphrodite individuals were found in this population. In September, the A stage (undetectable sex) was observed in 75% of cockles and might correspond to a previtellogenic phase rather than a sexual rest, as the percentage of *C. edule* showing the C stage (gonad maturation) increased in October to reach about 50% in November. The frequency of C stage was above 50% between November and April (Fig. 2A), and subsequently decreased in May (from 75 to 20%), thus corresponding to a slight decrease of the

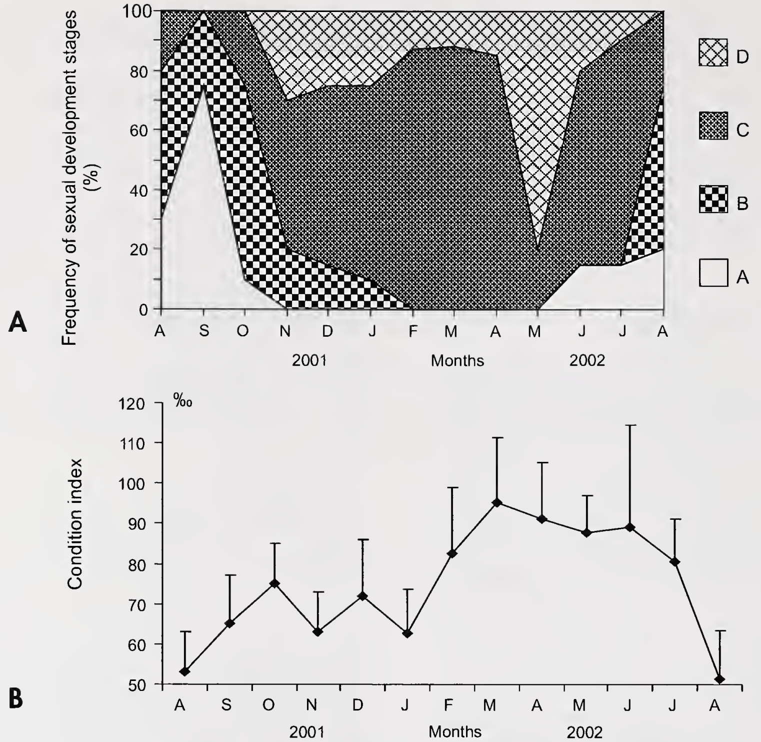

Figure 2. Distribution of sexual-development stages (A) according to the scale of LUCAS (1965) and annual cycle of condition indexes (B) in the populations of *C. edule* studied from August 2001 to August 2002. The cumulated frequencies of the different sexual-development stages corresponded to the total of bivalves studied (100%). For details of each stage, see Materials and Methods (Table I).
Figura 2. Distribución de los estadios de desarrollo sexual (A) según la escala de LUCAS (1965) y ciclo anual de índices de condición (B) en las poblaciones de C. edule *estudiadas entre agosto 2001 y agosto 2002. Las frecuencias acumuladas de distintos estadios de desarrollo sexual corresponden al total de bivalvos estudiados (100%). Véase Material y Métodos (Tabla I) para los detalles de cada estadio.*

condition index (Fig. 2B). An episode of partial spawning had thus occurred during this last period. In May, the frequency of the D stage (80%) proved that gametogenesis had resumed. In June and July, the C stage was the most frequent (65 to 75%) and was followed in August by a more marked decrease of the condition index (from 80 to 50‰) thus indicating an important release of gametes. It may be concluded that two periods of gamete maturation (C stage), the first ranging from November to April and the other occurring in June-July, were differentiated.

The histological study was carried out over a longer period of time (January 2001- March 2002) than the analysis of gonad smears. Mature gonads (IIIA stage) were often observed on more than 50% of cockles studied from January to April (Fig. 3). Episodes of partial spawning occurred from January to March; followed by another spawning in April and May (in May, the IIIB stage was noted in 60% of males, Fig. 3A). The reconstitution of the gonad (IIIC stage) is more marked in females (Fig. 3B) in May (80%) and seems more precocious in males. In both sexes, this stage developed in parallel from May to July so that partial spawning occurred during these months. In August, the IIIB stage was preponderant in both sexes (80% of

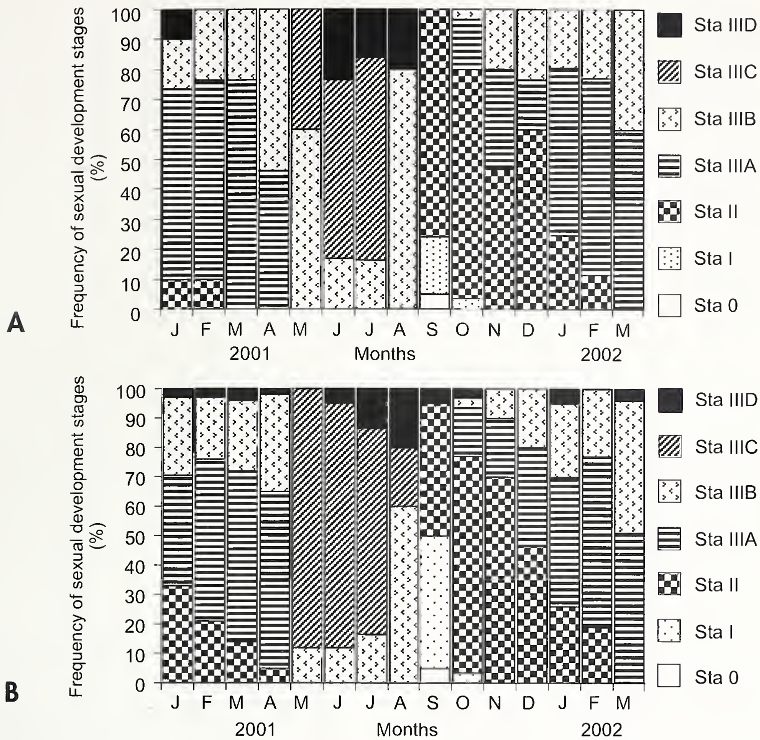

Figure 3. Distribution of gonadic-development stages over 2001-2002 in the males (A) and females (B) of *C. edule.* The cumulated frequencies of the different developmental stages corresponded to the whole bivalves studied (100%). For details of each stage, see Materials and Methods (Table I).

Figura 3. Distribución de los estadios de desarrollo gonadal sobre el periodo 2001-2001 en machos (A) y hembras (B) de C. edule. *Las frecuencias acumuladas de distintos estadios de desarrollo sexual corresponden al total de bivalvos estudiados (100%). Véase Material y Métodos (Tabla I) para los detalles de cada estadio.*

males, 60% of females), proving that the main spawning episode had happened. The resorption of gonads (IIID stage) was observed in a few individuals after the spawning of May and was less than 25% from June to August. Several females in IIID stage were noted during the other months, but they never exceeded 5%. In September, gametogenesis started in both sexes (I and II stages were found in 95% of cockles). The maturation of the gonad (IIIA stage) was observed in the first bivalves from October to December and partial spawning occurred from November to March.

The highest values (2.7) of the gonadic index (Fig. 4) were noted between January and April, thus confirming the presence of ripe gonads during this period. The lowest values (1.7) were found from June to August. In both sexes, the gonadic index was always higher than 1 so that the period of sexual rest was short.

Gametogenesis in the population of C. edule: Figure 5 gives the results of stereological analysis. From January to March, the percentages of mature gametes increased to peak in April. Another episode of gametogenesis began in May, as demonstrated by the high frequencies of young germinal cells during this month in both sexes. In males, the effect of this developing sper-

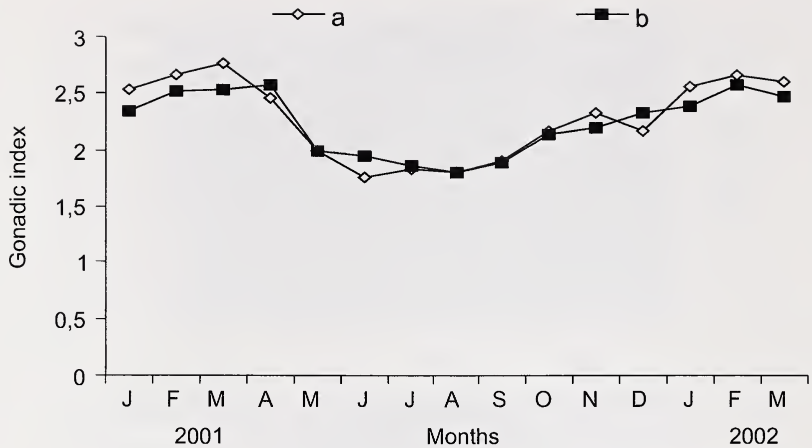

Figure 4. Annual cycle of the gonadic index in the males (A) and females (B) of *C. edule* over 2001-2002.
Figura 4. Ciclo anual del índice gonádico en machos (a) y hembras (b) de C. edule *en el periodo 2001-2002.*

matogenesis was high rates of spermatids and spermatozoa in June or August (grouped frequencies, 75% and 85%, respectively). In females, an important vitellogenesis was observed in May and June so that the highest frequency of mature oocytes (55%) was noted in July and that of degenerated oocytes (60%) in August. In September, the highest percentages of spermatogoniae (29%) in males and of oogoniae (37%) in females were noted, thus indicating the starting of another gametogenetic wave. From September to December, the gonadic tissue of males was important, as the grouped frequencies of spermatogoniae and of spermatocytes were more than 47%. The same finding was noted in females during this period (grouped rates of oogoniae and of vitellogenic oocytes, ≥70%). Low percentages of atresic oocytes (5-25%) were always observed in females throughout the year.

From the above study, it can be concluded that three successive gametogenetic waves were differentiated: the first one from January to April, the second one from May to July, and the third one from September to March. Ripe cockles for both sexes were predominant from January to April, in July, and from January to March.

Population dynamics: The lengths of *C. edule*, measured from January to December 2002, are given in Figure 6. The period of recruitment spanned from the end of spring to the onset of autumn. The first settlement of juvenile cockles occurred in June. A second cohort appeared in July, a third cohort in August, and a fourth one in October. At the end of autumn, the individuals recruited in June-July had a length of 18.3 ± 1.8 mm and constituted 71.6% of the population. By contrast, those originating from the grouped cohorts of August and October only had a length of 11.1 ± 1.1 mm and represented 9.2% of the population. In addition to these recruitments; a few young cockles (2-3%) were found for each date of sampling. In summer, there was a strong decrease in the number of cockles measuring 24.6 ± 1.9 mm in length. This diminution is followed by the almost complete disappearance of adult cockles just after the period of recruitment (August 2002) so that the population of *C. edule* in 2002 was mainly composed of young individuals which are being renewed each year.

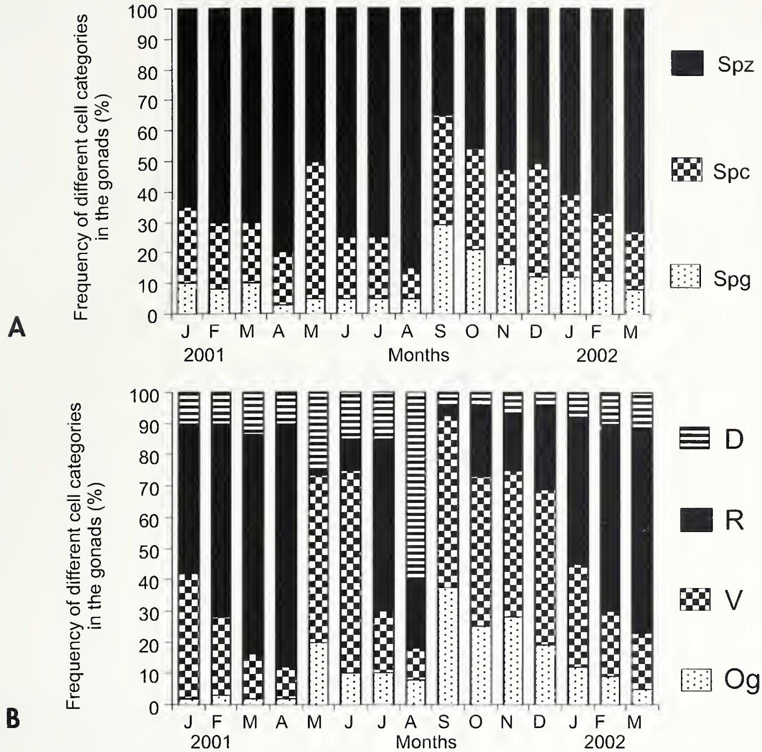

Figure 5. Frequencies of different cell categories in the male (A) and female (B) gonads of *C. edule* collected between January 2001 and March 2002. Male line: Spc (primary and secondary spermatocytes), Spg (protogoniae and spermatogoniae), Spz (spermatids and spermatozoa). Female line: D (degenerated oocytes), Og (oogoniae), R (mature oocytes), V (vitellogenic oocytes). The cumulated frequencies of the different cell categories corresponded to the whole bivalves studied (100%).
Figura 5. Frecuencia de distintas categorías de células en gónadas de machos (A) y hembras (B) de C. edule *recolectados entre enero 2001 y marzo 2002. En machos: Spc (Espermatocitos primarios y secundarios), Spg (protogonias y espermatogonias), Spz (espermatidios y espermatozoos); en hembras: D (ovocitos degenerados), Og (oogonias), R (ovocitos maduros), V (ovocitos vitelogénicos). Las frecuencias acumuladas de distintos estadios de desarrollo sexual corresponden al total de bivalvos estudiados (100%).*

Spatial distribution, biomass, and structure of population of C. edule before and after wastewater discharges

The spatial distribution of C. *edule* along the estuary, its density and its biomass are given in Table II for the summer surveys (2002 and 2003). During the period of wastewater discharge, the species was confined downstream (stations 1 and 2). By contrast, in 2003, its distribution had extended with an upstream penetration of cockles up to the station 5. The density of C. *edule* did not exceed 320 individuals/m^2 in 2002, and strongly increased in 2003 to reach values higher than 4,900 cockles/m^2 in several places (these values were found during the periods of recruitment). The mean biomass (AFDW) calculated on the cockle samples collected during summer surveys, increased from 2.54 g/m^2 in 2002 to 14.87 g/m^2 in 2003.

Table III shows the different groups of cockles constituting the population in summer surveys (2002 and 2003).

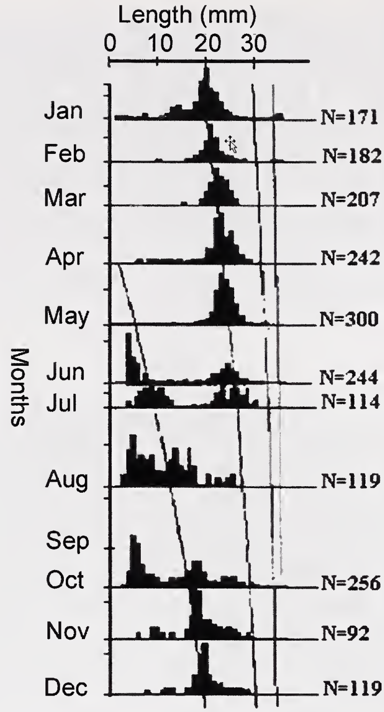

Figure 6. Size distribution of *C. edule* in the estuary of Oued Souss from January to December 2002 and the principal normal components. Month and numbers of individuals measured (N) are given for each sampling.
Figura 6. Distribución de tallas de C. edule *en el estuario del Oued Souss entre enero y diciembre 2002 y componentes normales principales. Meses y número de ejemplares medidos (N) están indicados para cada muestra.*

During the wastewater discharges in the estuary (July 2002), individuals are distributed among four groups: two classes with lowest lengths (6.81 ± 1.53 mm and 9.97 ± 0.83 mm), deriving from a recruitment in May and June; and two classes of old cockles (24,72 ± 2.17 mm and 27.5 ± 0,76 mm). In July 2003, the most frequent group (89.2%) was composed of young individuals (length, 6.55 ± 1.17 mm; 11.76 ± 1.63 mm) originating from a recruitment in May and June. Another group of medium size (36.25 ± 1.73 mm) appeared for the first time and probably comprised cockles more than one year old, as the absence of growth lines on cockle valves did not allow to easily identify the different age subgroups constituting this last size group.

DISCUSSION

The results reported in the present study on the gonochorism of *C. edule* agree with the reports of several authors (Gimazane, 1971; Kingston, 1974). Several cases of accidental hermaphrodism (4‰) were also noted by Fernandez Castro, Guillou, Le Pennec and Cardenas Lopez (1989). In the estuary of Oued Souss, the sex ratio of cockles was well-balanced so that pollution did not have an influence on the distribution of males and females. This finding agrees with studies that some authors have performed in other populations of *C. edule* at different latitudes, such as the report by Kingston (1974) along the coasts of Kent (UK), that of Ivell (1981)

Table II. Spatial distribution of *C. edule* along the estuary, its density and its Biomass (AFDWg /m^2) during wastewater contamination (summer 2002) and after stopping of pollution (summer 2003).
Tabla II. Distribución espacial de C. edule *a lo largodel estuario, su densidad y su biomasa (AFDW/m^2) durante vertidos de agua contaminada (verano 2002) y después de poner fin a la contaminación (verano 2003).*

Stations	Sampling sites	2002	2003	2002	2003
		Density (ind/m^2)		Biomass AFDW (g/m^2)	
0	0B		4		0.0012
	0bisA		872		32.368
	0bisB		24		0.08
1	1A	4		0.6492	
	1B		4		0.85
	1bis A		20		1.22
	1bisB	4	24	0.582	3.12
	1'A		36		0.446
	1'B		16		0.48
2	2A		108		0.28
	2B		6760		102.892
	2bisA	320		5.539	
	2bisB	112		3.648	
	2'A		4972		83.768
3	3A		8		0.1384
	3'A		432		3.7176
	3'B		636		6.8256
	3B		8		0.0416
4	4'A		16		0.074
	4'B		124		2.0676
5	5B		68		0.5248

in the Limfjord (Denmark), that of MEJUTO (1984) in Ria de Pasaxe (Spain), or still that of FERNANDEZ CASTRO, GUILLOU, LE PENNEC AND CARDENAS LOPEZ (1989) at Brouennou (France).

Through methods used for reproductive cycle analysis, complementary and concordant results were noted. In the year, two successive gametogenetic waves, the first occurring from September to April and the second in May-July, were differentiated in this population and spawning periods staggered over time. These phenomena can be explained by an effect of latitude (SOLA, 1997; RODRIGUEZ-RUA, PRADO, ROMEO AND BRUZON, 2003) and, in particular, by water temperature (HUGUES, 1971). When temperature was less than 10°C, it induced early spawning, followed by gonad reconstitution and a second period of spawning.

The presence of atresic oocytes observed throughout the year during vitellogenesis, as mentioned by LUBET (1991) is apparently a frequent phenomenon in bivalves noted in the start of gametogenesis (first mature oocytes degenerate), after partial spawnings and in the end of a reproductive cycle.

The long period of cockle recruitment (from June to October) in 2002 can

Table III. Distribution of shell lengths for C. edule during summer surveys (2002 and 2003): principal normal components.
Tabla III. Distribución de longitudes de conchas de C. edule *durante muestreos de verano (2002 y 2003): principales componentes normales.*

Group Nº	Structure of population					
	July 2002			July 2003		
	Percentage (%)	Mean of shell length (mm)	S.D	Percentage (%)	Mean of shell length (mm)	S.D
1	19.5	6.81	1.53	11.4	6.55	1.17
2	16.4	9.97	0.83	77.8	11.76	1.63
3	55.5	24.72	2.17	10.68	36.25	1.73
4	8.4	27.5	0.76			

be easily explained by spawning which occurred from April to August and this time was perfectly consistent with the gonadic-development stages determined by the histological study of gonads and the examination of gonad smears. Contrary to juveniles recruited in June-July which had a better development, those settled from August to October showed a great mortality. This last result would not be related to wastewater pollution, in agreement with the reports by MADANI (1989), SAURIAU (1992), BACHELET, GUILLOU AND LABOURG (1992a), or with that by BACHELET, DESPREZ, DUCROTOY, GUILLOU, LABOURG, RYBARCZYK, SAURIAU, ELKAÏM AND GLÉMAREC (1992b). According to these authors, high mortalities of cockles were noted in the recruitments which occurred at the end of summer, in autumn, and in winter. This mortality affected small-sized (<10 mm) cockles and may be explained by the almost complete absence of energetic reserves (SAURIAU, 1992) whereas the metabolism of young cockles was changing (GABBOTT, 1976).

By contrast, the disappearance of medium-sized molluscs in 2002 coincided with the period of summer recruitment. This finding might be explained, either by a great predation of cockles by *Haematopus ostralegus* (this bird only tackled on medium sizes as reported by ATKINSON, CLARK, BELL, DARE, CLARK AND IRELAND, 2003; Johnstone and Norris, 2000), or by a high rate of mortality for these bivalves, as their vulnerability became more marked with increasing age and was also dependent on the quality of waters and/or an eventual eutrophication in the estuary, as demonstrated by DUCROTOY AND IBANEZ (2002). Indeed, as sea waters in winter and spring had high loads of mineral seston in the absence of pollution, the filter-feeders produced numerous pseudo-faeces and had a marked energetic expense for selective sorting of particles, mucus secretion, and cleaning of gills for *Mytilus edulis* (WIDDOWS, FIETH AND WORRALL, 1979) or for *Crassostrea gigas* (HÉRAL, 1986). According to FOSTER-SMITH (1975a, b) and NEWELL (1977), the behaviour of adult cockles was different, as they adapted their pumping activity in the presence of high concentrations of mineral seston, with a passage by a relative state of dormancy (SAVARI, LOCKWOOD AND SHEADER, 1991). However, such a behaviour did not seem to exist during wastewater discharges in summer, as cockles were in reproduction and had to live in waters double loaded with matters in suspension (pollution) and the phyto-planktonic bloom (with the increase of temperature), therefore placing these bivalves under stress conditions and inducing a high mortality.

Since November 2002, the discharge of decanted wastewater in another site

beyond the estuary and the conversion of this ecosystem into a marine environment had resulted, for *C. edule*, in a wider spatial distribution, a strong increase of density, and the appearance of medium sizes in this site. To comment on these changes, it is necessary to take into account the reproduction of cockles living in this estuary, as it is stretched over all the year. Indeed, according to GORDO (1982), the reproductive cycle of Spanish and Portuguese populations of *C. edule* showed a period of sexual rest during summer months and the author explained it by the mean temperature of sea water which were more than 28°C and would inhibit the reproduction of this species, as they were close from the lethal temperature recorded for *C. edule* (ANSELL, BARNETT, BODOY AND MASSE, 1981). As the cockles from the estuary of the Oued Souss river practically did not have sexual rest and showed a gametogenesis starting towards autumn, the results noted in this site might be interpreted as an adaptation of this cockle population to high temperatures of sea waters which exist in the South of Morocco. Under these conditions, it is logical to consider *C. edule* an opportunistic species which might quickly overtake new areas in presence of favourable environmental conditions.

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Xylodiscula wareni n. sp., una nuova specie per le coste orientali della Sicilia

Xylodiscula wareni n. sp., una nueva specie para las costas orientales de Sicilia

Cesare BOGI* e Stefano BARTOLINI**

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RIASSUNTO

Si descrive un piccolo gasteropode planispirale, che non corrisponde a nessuna delle specie attualmente viventi nel Mar Mediterraneo, trovato in campioni di sedimento raccolti a profondità comprese tra i 35 e i 52 m lungo le coste siciliane. La forma generale della conchiglia ci ha indotto ad ascrivere questa specie, solo provvisoriamente, al genere *Xylodiscula* Marshall, 1988 anche se alcune caratteristiche della protoconca, non iperstrofica, lo escluderebbero.

Questa specie si descrive come nuova, con il nome di *Xylodiscula wareni* anche se probabilmente non appartiene a questo genere, evitando di descrivere al momento un nuovo genere scarsamente definito.

ABSTRACT

A small planispiral gastropod, which could not be ascribed to any known species from the Mediterranean or adjacent seas, was found in sediment samples collected in depths between 35 and 52 m in the seas around Sicily.

The general shape resmbles the genus *Xylodiscula* Marshall, 1988, but the protoconch is not heterostrophic and has a distinct sculpture not described from any gastropod. Therefore we describe this new species as *Xylodiscula wareni*, although it probably does not belong to the genus, instead of creating a new, poorly defined genus.

RESUMEN

Se describe un pequeño gasterópodo planiespiral recolectado entre 35 y 52 m de profundidad en las costas Sicilianas, que no pudo ser asignado a ninguna especie conocida del Mediterráneo ni de mares adyacentes. La forma general se asemeja al género *Xylodiscula* Marshall, 1988, aunque la protoconcha no sea heterostrófica y tenga una escultura distinta que no se conoce en ningún otro gasterópodo. Se propone como nueva especie *Xylodiscula wareni*. Aunque probablemente no pertenezca a este género, se descarta de momento la descripción de un género nuevo escasamente definido.

PAROLE CHIAVE: Gastropoda, Xylodisculidae, *Xylodiscula wareni*, nuova specie, Mar Mediterraneo, recente.
KEY WORDS: Gastropoda, Xylodisculidae, *Xylodiscula wareni*, new species, Mediterranean Sea, recent.
PALABRAS CLAVE: Gastropoda, Xylodisculidae, *Xylodiscula wareni*, nueva especie, mar Mediterráneo, reciente.

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INTRODUZIONE

Le nostre continue ricerche malacologiche e l'esame di numerosi campioni di sedimento raccolti lungo le coste della Sicilia Nord-Orientale e le isole antistanti, ci ha portato, questa volta, a studiare alcuni micromolluschi, in tutto quattro esemplari, isolati da piccole quantità di detrito raccolto a profondità variabili tra i 35 mt. e i 52 mt.

Il piccolo gasteropode di forma planorbide viene, per l'aspetto generale della conchiglia, solo provvisoriamente attribuito al genere *Xylodiscula* Marshall, 1988, in quanto le caratteristiche della sua protoconca, non iperstrofica, lo escluderebbero.

SISTEMATICA

Ordine HETEROSTROPHA Fischer P. , 1885
Famiglia XYLODISCULIDAE Waren A., 1992
Genere *Xylodiscula* Marshall,1988

Xylodiscula wareni n. sp. (Fig. 1)

Materiale esaminato: 1 esemplare (olotipo, fig.1 a-e) proveniente da detriti raccolti nel Luglio 2005 alla base della "Secca dei 6 metri" presso l'isola di Filicudi a -50 m. , 1 esemplare (paratipo A) raccolto nel Giugno 2006 a Cannizzaro, loc. Bellatrix, -35 m.di profondità lungo una parete rocciosa, 2 esemplari (paratipi B e C) provenienti da campioni di detriti coralligeni raccolti a Scilla a -52 m.
Materiale tipo: L'olotipo (Diam.= 1.1 mm), (Fig. 1A-E) è stato depositato nella collezione malacologia del Museo di Storia Naturale del Mediterraneo di Livorno, Italia, con il numero: Malacologia Vol. V, n. 734. I paratipi sono conservati nelle seguenti collezioni: il paratipo A (Diam.= 1.0 mm), nella collezione di S. Bartolini (Firenze), il paratipo B (Diam.= 1,3 mm) , e il paratipo C (Diam.= 1,2 mm), nella collezione E. Perna (Napoli).
Locus typicus: Detriti raccolti alla base della "Secca dei 6 metri" presso l'isola di Filicudi a -50 m. di profondità.
Etimologia: La specie è stata dedicata al Dottor Anders Warén, malacologo di fama mondiale e specialista, tra l'altro, nei piccoli "Skeneimorpha".

Diagnosi (olotipo): Conchiglia piccola, fragile, trasparente, di forma planorbide.La protoconca (fig.1 e) è costituita da 0.7 giri di spira di cui la parte iniziale è scolpita da piccole e irregolari depressioni.La teleoconca è costituita da circa 2 giri di spira attraversati da deboli linee di accrescimento. I giri si toccano solo per un breve tratto più o meno alla periferia del giro precedente e quindi la sutura risulta profonda e leggermente canaliculata. Spira arrotondata con la protoconca di poco sporgente nella parte superiore della stessa. Alla base della conchiglia è ben visibile per tutta la lunghezza della teleoconca, una evidente carena posizionata internamente all'ombelico. La bocca è di forma rotondeggiante con la parte inferiore leggermente espansa in prossimità della carena. La larghezza dell'ombelico è circa il 30% del diametro dell'intera conchiglia.

Dimensioni: Diametro= 1.1 mm.

Opercolo e parti molli ancora sconosciute.

Distribuzzione: La specie sembra avere una distribuzione ristretta a poche località delle coste siciliane, ed il suo habitat non sembra essere mai superficiale.

Discussione: L'attribuzione di questi esemplari al genere *Xylodiscula* è da ritenersi provvisoria in quanto solo lo studio delle parti molli potranno darne un'inquadramento tassonomico più congeniale. La forma generale della conchiglia in realtà corrisponde alle caratteristiche tipiche di questo genere, ma la protoconca differisce in quanto non ha uno sviluppo iperstrofico tipico della famiglia Xylodisculidae Warén, 1992.

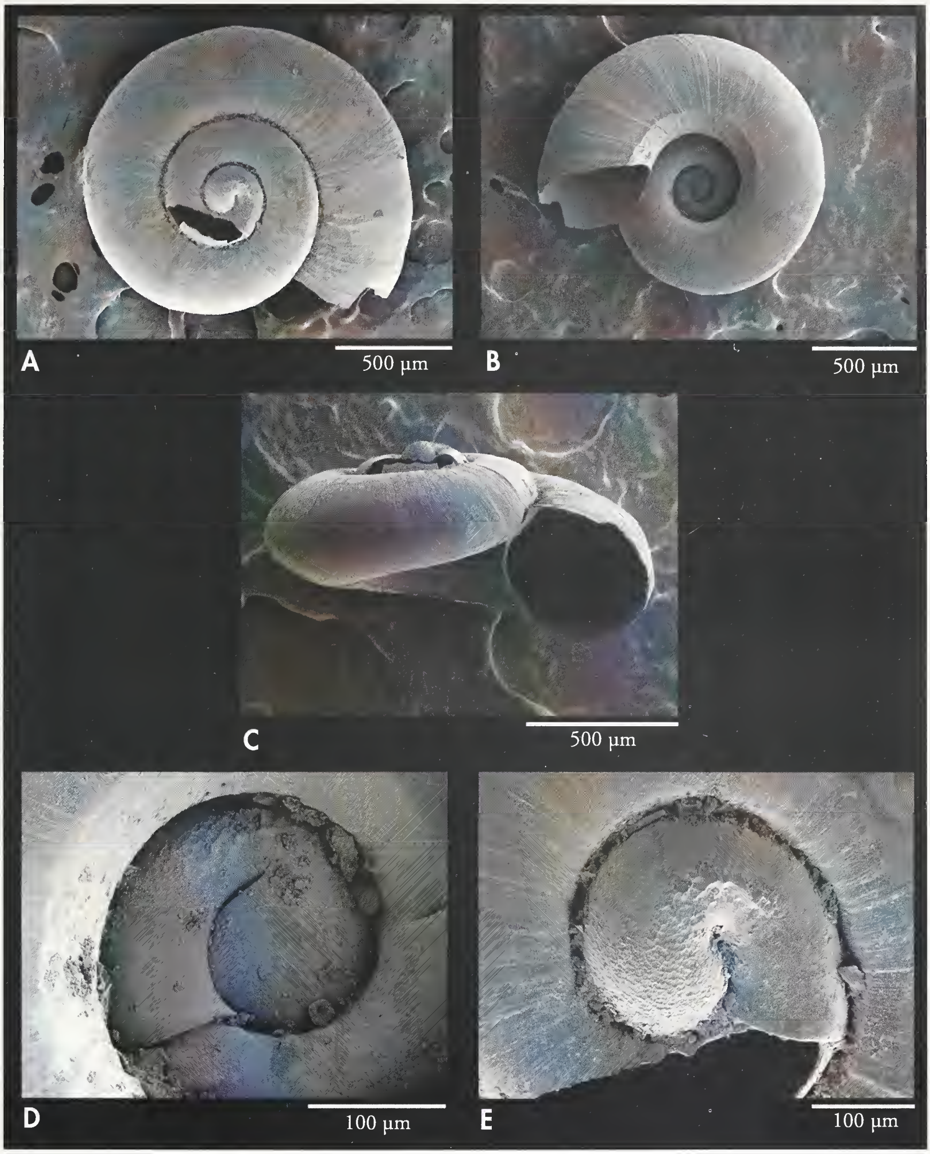

Figura 1. *Xylodiscula wareni* n. sp., Filicudi -50 m, olotipo (Museo di Storia Naturale del Mediterraneo di Livorno, Coll. Malac. N° Malacologia Vol. V n. 734). A: vista dall'alto; B: vista basale; C: vista frontale; D: dettaglio dell'ombelico; E: dettaglio della protoconca.

Figura 1. Xylodiscula wareni *n.sp., Filicudi -50 m, holotype (Museo di Storia Naturale del Mediterraneo di Livorno, Coll. Malac. N° Malacologia Vol. V n. 734). A: apical view; B: basal view; C: frontal view; D: detail of the umbilicus; E: detail of the protoconch.*

Il genere *Xylodiscula* è attualmente rappresentato nel Mar Mediterraneo da due specie: *X. boucheti* Warén, Carrozza e Rocchini, 1992, e *X. lens* Warén, 1992. Warén stesso nel suo articolo (Warén, 1992) evidenzia la difficoltà nel distinguere le due specie che differiscono quasi esclusivamente per il diametro

dell'ombelico che è il 30-33 % del diametro dell'intera conchiglia in *X. boucheti* mentre in *X. lens* è il 40%. La caratteristica principale che distingue *X. wareni* da queste due specie, come dalle altre non mediterranee appartenenti a questo genere, oltre alla diversa protoconca, è la presenza di una carena ben visibile alla base della conchiglia (Fig. 1B).

Abbiamo dubitato che gli esemplari potessero appartenere ad una specie dulciacquicola o terrestre, ma le nostre ricerche e l'opinioni di alcuni specialisti hanno escluso questa possibilità.

La specie tipo del genere, *Xylodiscula vitrea* Marshall, 1988, come pure *X. eximia* Marshall,1988, originarie rispettivamente dell'Australia e della Nuova Zelanda, sono state trovate su pezzi di legno affondati ed anche le specie descritte da Warén per il Mar Mediterraneo sono state raccolte viventi in un biotopo caratterizzato da fibre di *Posidonia* e frammenti di legno affondati.

Nei campioni di sedimento dove noi abbiamo trovato i pochi esemplari di *X. wareni*, non erano presenti frammenti di *Posidonia*.

RINGRAZIAMENTI

Un particolare ringraziamento al Dottor Anders Warén del Museo Svedese di Storia Naturale di Stoccolma, per aver eseguito le foto al SEM e per i consigli dati nella rilettura critica dell' articolo, e all'amico Edoardo Perna per aver messo a disposizione i suoi esemplari nonché le foto degli stessi. All'amico Ivano Niero per aver studiato gli esemplari come eventuali appartenenti alla fauna continentale.

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The colour white diminishes weight loss during aestivation in the arid-dwelling land snail *Sphincterochila (Albea) candidissima*

El color blanco disminuye la pérdida de peso durante la estivación en el caracol de medios áridos *Sphincterochila (Albea) candidissima*

Gregorio MORENO-RUEDA*

Recibido el 14-V-2007. Aceptado el 2-I-2008

ABSTRACT

It has been suggested that white colour is beneficial for snails living in arid environments. In this work, shell coloration in the arid-dwelling land snail *Sphincterochila (Albea) candidissima* was manipulated during aestivation. Snails painted black lost more body weight than did control ones, presumably as a consequence of higher heat absorption. This suggests that light colour is advantageous for this land snail.

RESUMEN

Se ha sugerido que el color blanco es beneficioso para los caracoles en ambientes áridos. En el presente trabajo se manipula la coloración de la concha en el caracol de medios áridos *Sphincterochila (Albea) candidissima* durante la estivación. Los caracoles pintados de negro perdieron más peso que los caracoles que sirvieron como control, presumiblemente como una consecuencia de una mayor absorción de calor. Esto sugiere que los colores claros son ventajosos para este caracol.

KEY WORDS: *Sphincterochila candidissima*, arid environments, colouration.
PALABRAS CLAVE: *Sphincterochila candidissima*, medios áridos, coloración.

INTRODUCTION

It is well established that tegument colour has important functions in camouflage, as well as in communication (e.g., BADAYEV AND HILL, 2000; THÉRY, DEBUT, GOMEZ AND CASAS, 2005; EXNEROVA, SVADORA, BARCALOVA, LANDOVA, PROKOPOVA, FUCHS AND SOCHA, 2006). The colour of teguments depends on the wavelengths that are reflected. Therefore, colouration affects the energy that is absorbed by the tegument, the amount being higher as the colour darkens. In this sense, animal colouration may also have a role in thermoregulation, especially important for arid-dwelling animals (CLOUDSLEY-THOMPSON, 1978). Terrestrial molluscs are very susceptible to dehydration (PRIOR, 1985; LUCHTEL AND DEYRUP-OLSEN, 2001), and therefore need adaptations to survive in arid envi-

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ronments. White colour may favour the success of land-snails in warm environments: White shells have a higher reflectance of sunlight (Schmidt-Nielsen, Taylor and Shkolnik, 1971), and, as a consequence, land snails with light-coloured shells register lower body temperatures (Heath, 1975), thereby improving survival under high temperatures (Richardson, 1974). This translates as a selective pressure for whiter shells in arid environments and, in fact, some studies have correlated shell colour with environment temperature (Jones, 1973; but there are exceptions: Heller, 1984).

The snails of the genus *Sphincterochila* have white shells. In Sierra Elvira (SE Spain), *Sphincterochila (Albea) candidissima* (Draparnaud, 1801) is the most abundant gastropod (Moreno-Rueda, 2002). Sierra Elvira has an arid environment, and sheltering in protective microhabitats may be a vital strategy against dehydration (Steinberger, Grossman, Dubinsky and Shachak, 1983; Arad, Goldenberg and Heller, 1989; Cook, 2001). However, *S. candidissima* does not use refuges during drought periods (spring and summer) (Moreno-Rueda, 2007; Moreno-Rueda and Collantes-Martín, 2007). Because the shell of *S. candidissima* is pure white, I hypothesized that shell colour might contribute to the survival of *S. candidissima* in Sierra Elvira, explaining why this snail does not need refuges against dehydration. I investigated this hypothesis by manipulating the shell colour of *S. candidissima* during aestivation (painting some snails), and by examining the effect of this manipulation on the amount of body mass lost. About 80-90% of fresh body weight (shell not included) of *Sphincterochila* land snails is water, and, therefore, a decrease in body weight suggests a loss of water (Schmidt-Nielsen *et al.*, 1971; Yom-Tov, 1971; Steinberger, Grossman and Dubinsky, 1981).

METHODS

This study was performed in Sierra Elvira (SE Spain, 37º 15′ N, 3º 40′ W), a small mountain range with a dry mesomediterranean climate (UNESCO, 1963). The study area undergoes five months of drought each year, with an average annual precipitation of 600-1000 mm (Alonso, López-Alcántara, Rivas and Ibáñez, 1985). It is, therefore, a dry zone for land snails. Table I presents climatic data during the study period, measured from the meteorological station of Pinos Puente, about three kilometres from the study area, and approximately at the same altitude (630 m. a.s.l.).

Sphincterochila candidissima is the only species of the genus *Sphincterochila* in Sierra Elvira (Ruiz Ruiz, Cárcaba Pozo, Porras Crevillén and Arrébola Burgos, 2006). In the study area, this species begins aestivation in April-May (Moreno-Rueda, 2007; Moreno-Rueda and Collantes-Martín, 2007). This snail adheres to rock or vegetation during aestivation. For manipulation, snails were not separated from the substrate, because this could provoke dehydration in the snails (Luchtel and Deyrup-Olsen, 2001). For this reason, I could not measure body mass before treatment, but I collected 75 additional individuals in order to analyse the relationship between shell morphology and body mass. The experiment started on 26 June 2005. Each individual found was sequentially assigned to the control group (C), to the control of manipulation group (CM), or to the experimental group (E). Manipulation in control group was only a mark for recognition. Snails in the CM group were painted in yellow with a marker. Paint covered approximately 50% of shell surface. In the experimental group, the shell was painted black with a marker in the same way as in CM group. In total, 52 snails were used in each group (n = 156). The study area was prospected two months later (26 August 2005). Snails found were collected and measured (shell height and width) with a calliper (accuracy 0.01 mm.) and weighed with a digital balance (accuracy 0.1 g.).

Table I. Climatic data of the meteorological station of Pinos Puente, located near of the study area, for the study period (06/26/2005 to 08/26/2005).
Tabla I. Datos climáticos de la estación meteorológica de Pinos Puente, próxima a la zona de estudio, para el período de estudio (26/06/2005 a 26/08/2005).

	Mean	S.E.	Minimum	Maximum
Daily maximal temperature (ºC)	36.8	0.36	30.7	42.9
Daily minimal temperature (ºC)	17.6	0.30	12.7	22.8
Average daily temperature (ºC)	27.0	0.27	23.4	31.3
Daily radiation (MJ/m^2)	27.6	0.51	13.9	32.5
Daily precipitation (mm.)	0.03	0.02	0.00	0.80

Table II. Average weight on the day 08/26/2005, and shell height and width for the snails in the experimental (E), control (C) and control of manipulation (CM) groups. The last row shows the average weight after statistically controlling for shell height and width. The last column shows the results of ANOVA and ANCOVA. In brackets is the standard error.
Tabla II. Peso promedio el día 26/08/2005, y altura y anchura de la concha para los caracoles en el grupo experimental (E), control (C) y control de la manipulación (CM). La última fila muestra el peso promedio después de controlar estadísticamente por la altura y anchura de la concha. La última columna muestra los resultados de los tests de ANOVA y ANCOVA. Entre paréntesis el error estándar.

	E group	C group	CM group		ANOVA	
	n = 29	*n* = 34	*n* = 30	*F*	*d.f.*	*P*
Weight (g.)	2.70 (0.09)	3.02 (0.09)	2.87 (0.09)	3.15	2, 90	< 0.05
Width (mm.)	21.49 (0.22)	21.31 (0.21)	21.33 (0.22)	0.21	2, 90	0.81
Height (mm.)	16.54 (0.18)	16.77 (0.17)	16.37 (0.18)	1.33	2, 90	0.27
Weight (controlled for shell size)	2.69 (0.07)	3.00 (0.06)	2.91 (0.07)	6.28	2, 88	< 0.003

The variables had a distribution similar to normal (Kolmogorov-Smirnov test, $p > 0.05$), and parametric statistics were used. An ANOVA was used to test the effect of the treatment on body weight, and an ANCOVA was used controlling by snail body size (height and width). For post hoc comparisons the Fisher LSD test was used. The Chi-square was used to test the probability of survival according to treatment.

RESULTS

In August, I recaptured 34 snails alive in the control group, 30 for the CM group, and 29 of the experimental group. The frequency of recaptures did not differ significantly between the three groups ($\chi^2_2 = 1.12$; $p = 0.57$). When individuals were collected in August, there were significant differences for body mass between the treatments (Table II). Individuals of the experimental group weighed less than those in the control one (post hoc Fisher LSD, $p = 0.01$), while the average weight in the CM group was intermediate between the other two groups (post hoc, CM vs. C, $p = 0.22$; CM vs. E, $p = 0.22$). In the additional sample of 75 individuals, body mass was strongly predicted by shell morphology (Multiple Regression Model; $R^2 = 0.81$; $F_{2,72} = 149.0$; $p < 0.001$; equation: Body mass = -5.16 (SE = 0.46; $t_{72} = 11.2$) + 0.28 (SE = 0.03; $t_{72} = 10.2$) x Width + 0.14 (SE = 0.03; $t_{72} = 5.1$) x Height). There were no significant differences for body size (height and

width) between the three groups (MANOVA, Wilks = 0.94; $F_{4, 178} = 1.46$; p = 0.22; Table II), suggesting that initial body mass did not differ among groups. When the analyses were repeated with shell height and width as a covariate, differences in weight between groups were accentuated (ANCOVA, $F_{2, 88} = 6.28$; $p < 0.003$; Height effect: $F_{1, 88} = 10.90$; p = 0.001; Width: $F_{1, 88} = 21.98$; $p < 0.001$; Table II). Differences between the control group and the experimental group increased in this analysis (post hoc, $p < 0.001$), while body weight in the CM group remained intermediate between the other two groups (CM vs. C, p = 0.08; CM vs. E, p = 0.08).

DISCUSSION

The findings of this experimental study show that shell colour alteration in *Sphincterochila candidissima* during aestivation had effects on weight loss, snails with shells painted black suffering a quicker loss of weight than control snails. The most probable mechanism behind this result is that light reflection was lower in shells painted in black, and for this reason they trapped more heat, as shown in other studies with other species of snails (e.g., Heath, 1975). The higher the body temperature, the higher the water loss, decreasing body weight (Yom-Tov, 1971). Body size may affect the interaction between shell colour and heat absorption (Slotow, Goodfriend and Ward, 1993), but there were no differences in body size between the groups, and differences in weight remained significant after controlling statistically for shell morphology. This weight loss presumably harms fitness, increasing the risk of mortality, especially for the smallest individuals (with less reserves), or in very dry years (Richardson, 1974). Moreover, the treatment lasted only two months (although the warmest), but *S. candidissima* aestivates for 5-7 months in the study area (Moreno-Rueda and Collantes-Martín, 2007), and therefore, the effect should be more accentuated if the entire aestivation period is considered.

The control of manipulation (CM) group, with shells painted in yellow, had weight values intermediate to the other two groups. In fact, this group is not a true control of manipulation, as colour was altered with respect to unmanipulated snails. Because their shells were darker than shells in the control group, but lighter than shells in the experimental group, the results support that weight loss is due to shell colour. As weight for the CM group was intermediate, if there was an effect of paint on weight, this cannot completely explain the differences between the control and the experimental group.

Therefore, results presented here and in the literature strongly suggest that the white colour is advantageous for survival in arid-dwelling snails. The question arises as to why white colour is not more widespread in arid environments (see, for example, Heller, 1984). Other selective mechanisms besides thermal selection act on shell colour, such as predation (Jones, Leith and Rawlings, 1977). Lighter shells, especially those with a pure white colour as in *Sphincterochila candidissima*, are usually easier to detect by predators (Reed and Janzen, 1999). However, predation on *Sphincterochila candidissima* is rare due to its thick shell (Yanes, Suárez and Manrique, 1991), and thus the absence of a strong selection by predators in this species would favour the maintenance of pure white shells.

In conclusion, this study, applying an experimental approach, supports the hypothesis that shell colour affects weight loss in arid-dwelling land-snails, and, as a consequence, fitness, by a mechanism mediated by thermoregulation.

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Notes on the genus *Anadema* H. and A. Adams, 1854 (Gastropoda: Colloniidae)

Notas sobre el género *Anadema* H. y A. Adams, 1854 (Gastropoda: Colloniidae)

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ABSTRACT

Shell morphology and characters of the living animal of the poorly known, Atlantic Moroccan species *Anadema macandrewii* (Mörch, 1864) are described and illustrated, based on beach collected specimens and a single live-collected specimen. The genus is monotypic and is assigned to the Colloniidae rather than Turbinidae because of the dome-shaped profile of the shell, open umbilicus, symmetrical tooth rows of the radula, lack of cephalic lappets, and the non-bicarinate juvenile shell. Within the Colloniidae, it unusual for its relatively large mature shell, juvenile shell with a keeled profile, and the lack of the secondary flap above the rachidian tooth. The species is regarded as sexually dimorphic, with the female shell having a raised periumbilical rim comparable to that of other trochoideans modified for brooding by means of an enlarged umbilical cavity.

RESUMEN

Se describe e ilustra la morfología de la concha y del animal vivo de *Anadema macandrewii* (Mörch, 1864), una especie poco conocida de la costa atlántica de Marruecos. El género es monotípico y se asigna a la familia Colloniidae, en lugar de a los Turbinidae por la forma abombada de la concha, el ombligo abierto, las filas de dientes radulares simétricas, la ausencia de lóbulos cefálicos y por su concha juvenil no bicarenada. Entre los Colloniidae, la especie es insólita por el tamaño relativamente grande de la concha adulta, el perfil de la concha juvenil con una quilla y la ausencia de un repliegue secundario sobre el diente raquídeo. Se considera que existe dimorfismo sexual en esta especie, pues la concha de la hembra tiene un reborde periumbilical elevado comparable con el de otros trocoideos modificados para incubar en una cavidad umbilical ampliada.

KEY WORDS: Trochoidea, Morocco, brooding, endemism.
PALABRAS CLAVE: Trochoidea, Marruecos, incubación, endemismo.

INTRODUCTION

The poorly known genus *Anadema* H. and A. Adams, 1854 has at times been regarded as a trochid, a liotiid, a colloniid, and a turbinid. Here we

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review the taxonomy and update what is now known about the type and only known species of this genus.

Anadema was proposed for the combination *Omphalius (Anadema) caelata* A. Adams, 1854, an Atlantic Moroccan species then thought to be a trochid in the absence of data on a calcified operculum. The species was not to be illustrated until 19 years later but it was described in sufficient detail that its identity has never been in question. In his remarks that followed the Latin description of the species, ADAMS (1855: 39) wrote: "The character of this shell is so peculiar, on account of the internal spiral callus of the umbilicus, and the absence of characters which constitute allied forms, that I propose to consider it a subgenus of *Omphalius*, under the name of *Anadema*." The generic name *Omphalius* Philippi, 1847 now pertains to the Tegulinae, as defined by HICKMAN AND MCLEAN (1990).

Ten years after the introduction of *Anadema*, MÖRCH (1864: 46) reported that a living specimen had been collected at the type locality. Mörch stated that: "*Omphalius (Anadema) caelata* is provided with a calcareous operculum, which proves that this species may be removed to *Turbo*. As there is already a *T. caelata*, L., I propose for this species *Turbo macandrewii*." Mörch's placement of the species in *Turbo* predated most work on the genera of turbiniform gastropods, and was based on the assumption that any turbiniform species with a calcareous operculum could only be a *Turbo*. This was unfair to Arthur Adams, but the ICZN rules about secondary homonymy force us to abandon the original name and to use the replacement name. This name honors the rediscoverer Robert McAndrew, who dredged a living specimen at Mogador (now Essaouira), the type locality of the species.

The first shell figure known to us was provided still later by P. FISCHER (1873), who used the replacement name *Turbo macandrewii;* this is a drawing that has been copied by many subsequent authors. The operculum has never been figured and the repository of the operculate specimen examined by Mörch is unknown.

PILSBRY (1888) ignored the replacement name and called it *Leptothyra caelata*, a not unreasonable choice, as it hardly resembles a species of *Turbo*. *Leptothyra* is now assigned to Colloniidae.

WENZ (1938: 340) recognized the genus *Anadema* and placed it in the turbinid subfamily Liotiinae, under a broad definition in which he also included genera with calcareous opercula related to *Homalopoma*.

KEEN (1960: 270) placed *Anadema* in the more restricted Homalopomatinae, a group with fully calcified operculum, now subsumed under the turbinid subfamily Colloniinae in the classification of HICKMAN AND MCLEAN (1990).

NORDSEICK (1968: 33) overlooked MÖRCH (1864) and placed it in Liotiinae: "Deckel spiralig und mit Kalkbesatz, nicht verdickt", apparently having assumed that it must have the opercular definition of the now understood Liotiidae, in which the operculum is multispiral with calcareous beads on the outer surface.

Resolution of the uncertainty is here provided by a preserved immature specimen with operculum, which was collected by the second author in 1991 at Essaouira (formerly Mogador), the type locality. We therefore take this opportunity to illustrate the species and confirm its placement.

MATERIALS

This report is based on material collected by the second author, which is now in the malacology collection of the Muséum National d'Histoire Naturelle, Paris (MNHN). The external features of the single live-collected specimen were drawn with the animal fully extended. Subsequent preservation of the specimen resulted in retraction within the shell. It was later critical-point dried for SEM examination, after which it was rehydrated for extraction of the radula for SEM analysis.

SYSTEMATICS

Superfamily Trochoidea Rafinesque, 1815

Hickman and McLean (1990) divided the family Turbinidae into a number of subfamilies, including Liotiinae, Colloniinae, and Turbininae. However, Williams and Ozawa (2007) have reported that their data toward a molecular phylogeny of the family Turbinidae indicates that there are two well-supported groups within the previously defined Turbinidae, which therefore precludes the placement of all of the subfamilies in the same family. In view of the ongoing reconsideration of the relationships among these groups, we here treat the Liotiidae, Colloniidae, and Turbinidae at the family level within the superfamily Trochoidea, which simply raises the ranking in the existing classification. This has already been adopted by McLean and Kiel (2007). Additionally, and without discussion, Warén and Bouchet *in* Bouchet and Rocroi (2005: 245) have separated Turbinoidea and Trochoidea at the superfamily level, which also indicates that the higher classification for trochiform vetigastropods is currently unsettled.

Family Colloniidae Cossmann, 1916
Subfamily Colloniinae Cossmann, 1916

Hickman and McLean (1990) provided an extensive treatment of the Colloniidae (then as Colloniinae), distinguishing them from Turbinidae (then as Turbininae) on their smaller size, non-bicarinate juvenile shell, lack of cephalic lappets, symmetrical tooth rows and inner lateral teeth that are not greatly enlarged. This is in contrast with the Turbinidae, characterized by larger size, bicarinate juvenile shell, asymmetrical tooth rows and enlarged inner lateral teeth of the radula.

McLean and Kiel (2007) distinguished two subfamilies within the Colloniidae, based on opercular morphology: the basal and mostly extinct Petropomatinae Cox *in* Knight *et al.*, 1960, having a calcified operculum that is conical on the inner surface, with a fully multispiral pattern, and the Colloniinae, in which the operculum is flat on the inner surface with a multispiral pattern that changes to broadly paucispiral on the final volution. There is one living genus (*Liotipoma* McLean and Kiel, 2007) of Petropomatinae, whereas there are numerous living and fossil genera of Colloniinae.

Genus *Anadema* H. and A. Adams, 1854

Anadema H. and A. Adams, 1854: 430 [as subgenus of *Omphalius* Philippi, 1847]. Type species (monotypy): *Omphalius (Anadema) caelata* A. Adams *in* H. and A. Adams, 1854 [= *Turbo macandrewii* Mörch, 1864; not *Turbo caelata* Linnaeus, 1758].

Anadema macandrewii (Mörch, 1864) (Figs. 1-23)

Omphalius (Anadema) caelata A. Adams, *in* H and A. Adams, 1854: 430 [as type of new subgenus]. A. Adams, 1855: 39 [more detailed description].

Turbo macandrewii Mörch, 1864: 46 [new name for secondary homonym *Omphalius (Anadema) caelata*, not *Turbo caelata* Linnaeus, 1758].

Turbo macandrewi. Fischer, 1873: 98, pl. 29, fig. 3 [first illustration]. Pasteur-Humbert, 1962: 132 [listed].

Leptothyra coelata [sic]. Pilsbry, 1888: 255, pl. 48, fig. 38 [figure after Fischer].

Turbo (Anadema) macandrewi. Pallary, 1920: 63.
Anadema coelata [sic]. Wenz, 1938: 340, fig. 795 [figure after Fischer]. Nordesick, 1968: 33, fig. 17.00
Anadema caelata. Keen, 1960: 270 [no figure]. Trew, 1992: 19 [listing of species described by H.& A. Adams].

Material examined: BMNH, 2 syntypes, BMNH 1968183, Mogador (now Essaouira), Atlantic Morocco (height 12.3 mm, diameter 16.6 mm; height 12.1 mm, diameter 17.3 mm). MNHN, Essaouira (formerly Mogador), Atlantic Morocco (31° 31′ N, 9° 47′ W), 1 live-collected male specimen and several beach-worn shells, leg. Gofas, 23 September 1991. MNHN, El Jadida, Atlantic Morocco (33° 16′ N, 8° 29′ W), beach worn shells, leg. Gofas, 26 September, 1991. MNHN, Mohammedia (formerly Fedala), Atlantic Morocco (33° 43′ N, 7° 21′ W), 10 beach-worn shells, leg. Gofas, 1970-71.

Description: Because the genus is monotypic, the description that follows applies both to the genus and species.

Shell composed of 5 whorls with a low spire; profile dome-shaped, broader than high, suture not impressed; whorls weakly rounded, periphery of immature shell strongly projecting, forming a keel; periphery spinose in early stages, but losing spination at maturity; mature shell with a subangulate base; axial sculpture of fine, raised lamellae; spiral sculpture of low, strongly beaded cords; cords between suture and beaded basal cord increasing from three in juvenile to 6 at maturity; base slightly convex, basal cords of comparable strength and beading to those of body whorl, increasing from three in juvenile to 8 at maturity; spiral sculpture of both body whorl and base separated by narrow interspaces; axial lamellae well developed in interspaces but not expressed on surface of nodular beads; umbilicus open in juvenile shell, closed in male shell at basal diameter of 9 mm; remaining open in female shell; umbilicus of mature female shell bordered by raised, unbeaded peripheral cord that partially obstructs final quarter whorl and connects directly at base of aperture; aperture oblique, thickened within, descending slightly on final whorl; interior nacreous, inner wall of aperture of female shell smooth, edge with U-shaped sinus; shell colour brick-red.

Shell dimensions. Mature female shell (Figs. 1-3): height 13.0, diameter 17.1 mm; immature male shell (Figs. 4-6): height 4.9, diameter 9.1 mm; maximum dimensions possible for male shell unknown; immature female shell (Figs. 7-9), height 5.9, diameter 9.1 mm.

(Right page) Figures 1-15. *Anadema macandrewii* (Mörch, 1864). 1-3: Mature, beach-worn female shell, from Essaouira, Morocco (MNHN), 3 views, height 13.0 mm, diameter 17.1 mm; 4-6: live-collected, immature male specimen with operculum in place, same locality (MNHN), 3 views, height 4.9 mm, diameter 9.1 mm; 7-9: immature, beach-worn female shell, from Mohammedia, Morocco (MNHN), 3 views, height 5.9 mm, diameter 9.1 mm; 10, 11: juvenile beach-worn shell, from Essaouira, Morocco (MNHN), 2 views, height 2.1 mm, diameter 5.0 mm; 12,13: juvenile shell with protoconch showing in umbilical view, from Essaouira, Morocco (MNHN), 2 views, diameter 2.7 mm; 14, 15: operculum of specimen shown in Figures 4-6 and 16, exterior and interior views, maximum diameter 2.1 mm.

(Página derecha) Figuras 1-15. Anadema macandrewii *(Mörch, 1864). 1-3: Concha adulta, explayada, de una hembra, de Essaouira, Marruecos (MNHN), 3 vistas, altura 13,0 mm, diámetro 17,1 mm; 4-6: ejemplar macho inmaduro, recolectado vivo, con el opérculo cerrando la concha; misma localidad (MNHN), 3 vistas, altura 4,9 mm, diámetro 9,1 mm; 7-9: concha inmadura, explayada, de una hembra, de Mohammedia, Marruecos (MNHN), 3 vistas, altura 5,9 mm, diámetro 9,1 mm; 10, 11: concha juvenil explayada, de Essaouira, Marruecos (MNHN), 2 vistas, altura 2,1 mm, diámetro 5,0 mm; 12, 13: concha juvenil con la protoconcha visible desde el ombligo, de Essaouira, Marruecos (MNHN), 2 vistas, diámetro 2,7 mm; 14, 15: opérculo del ejemplar representado en las Figuras 4-6 y 16, vistas exterior e interior, diámetro máximo 2,1 mm.*


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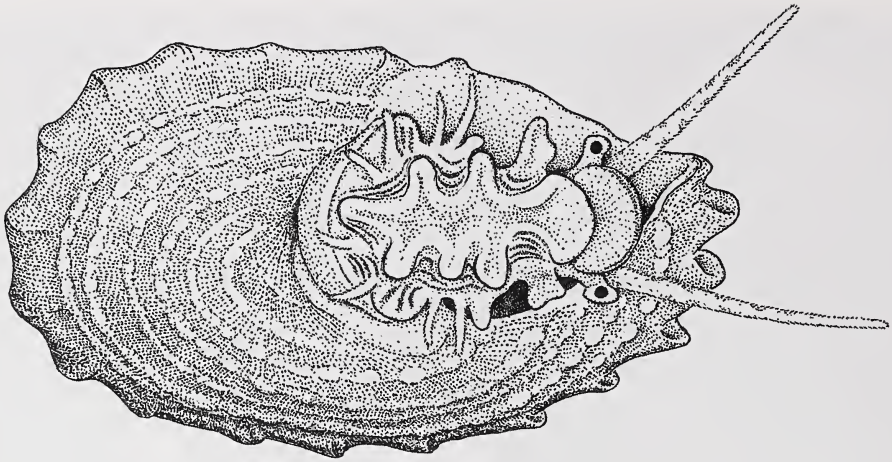


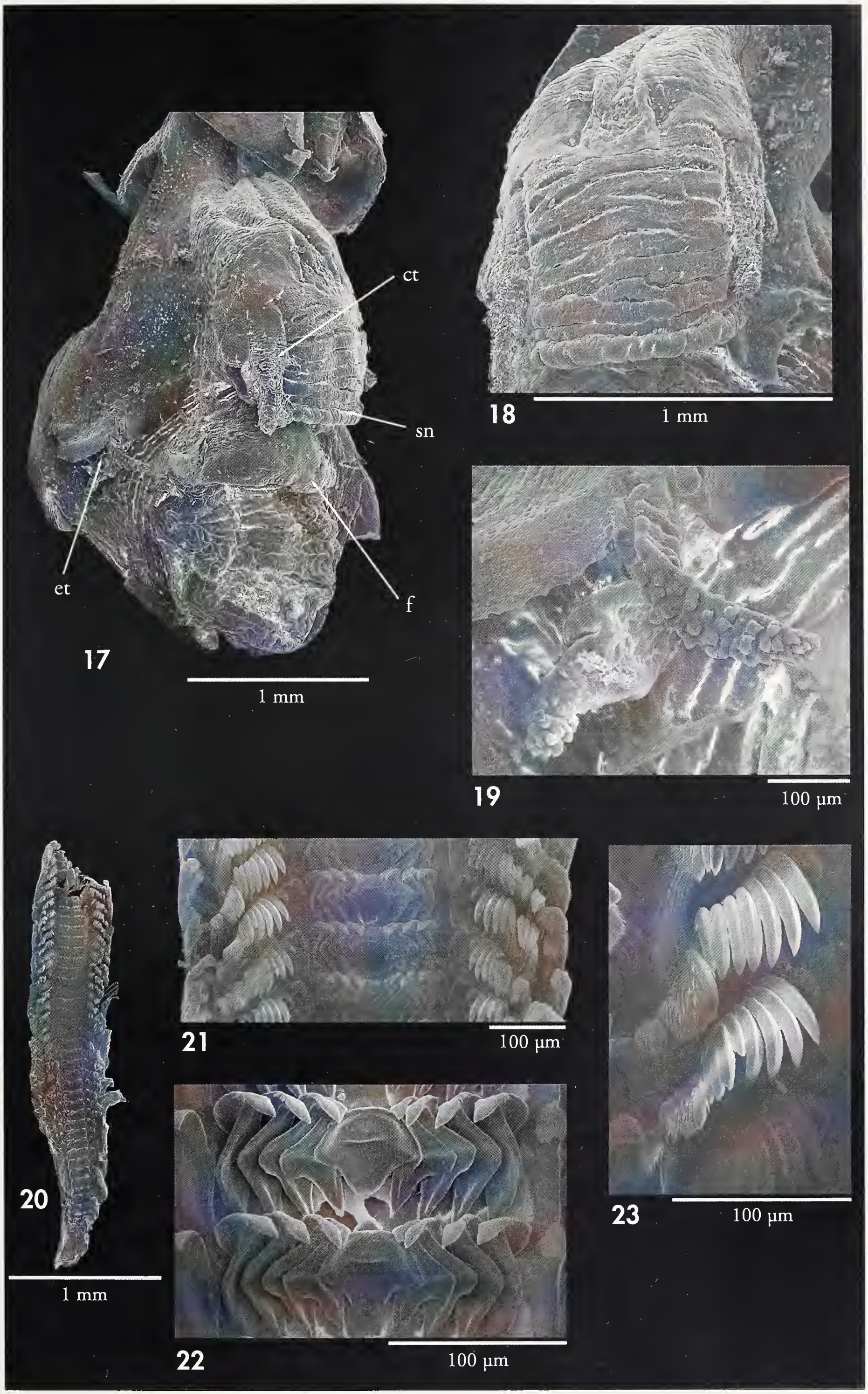
Figure 16. *Anadema macandrewii* (Mörch, 1864). Drawing of living specimen shown in Figures 4-6.
Figura 16. Anadema macandrewii *(Mörch, 1864). Dibujo del animal vivo, del mismo ejemplar de las Figuras 4-6.*

Juvenile shell (Figs. 10-13) not with raised axial lamellae, of low profile, exposing protoconch and early whorls in basal view; profile not equally bicarinate, the upper carination spinose and more strongly projecting than lower, non-spinose carination; protoconch and first teleoconch whorl positioned slightly below level of second whorl.

Operculum (Figs. 14-15) calcareous, thick, with a concavity at the base where the white outer surface is coloured light reddish-brown. There is a strong ridge and groove of similar width leading to the upper part, which bears strong pustules in the region adjacent to the columella; outer edge with a narrow groove; inner surface becoming broadly paucispiral in final volution. This operculum is chipped or somehow reduced at its inner edge, to the extent that the outline is not oval; the chitinous layer of the inner surface that shows at the lower left of Figure 15 is missing at the upper left.

Head-foot (Figs. 16-19). Head proportionally large, provided anteriorly with a snout terminating in a broad,

(Right page) Figures 17-23. *Anadema macandrewii* (Mörch, 1864). 17-19. Scanning electron micrographs of critical-point dried specimen, same as shown in Figure 16. 17: general view of head-foot; 18: close-up of snout; note the absence of cephalic lappets; 19: close-up of right anterior bundle of epipodial tentacle. 20-23. Scanning electron micrographs of the radula, same specimen as Figure 16. 20: complete radula; 21: close-up of several complete rows; 22: detail of central and lateral teeth; 23: detail of marginal teeth. Abbreviations, ct: cephalic tentacle; et: epipodial tentacles; f: foot (pointing to propodium); sn: snout.
(Página derecha) Figuras 17-23. Anadema macandrewii *(Mörch, 1864). 17-19. Micrografías electrónicas de barrido del ejemplar de la Figura 16 deshidratado por punto crítico. 17: vista general de la cabeza y del pie; 18: vista aumentada del hocico; nótese la ausencia de lóbulos cefálicos; 19: vista aumentada de un haz anterior derecho de tentáculos epipodiales. 20-23. Micrografías electrónicas de barrido de la rádula, ejemplar de la Figura 16. 20: radula completa; 21: vista aumentada de algunas filas completas; 22: detalle de los dientes centrales y laterales; 23: detalle de los dientes marginales. Abreviaturas, ct: tentáculo cefálico; et: tentáculos epipodiales; f: pie (señalado el propodio); sn: hocico.*


ct
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17
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flattened area surrounding the mouth, laterally with two prominent, smooth bulges containing rather large, black eyes and, next to these on the anterior side, two slender, villose cephalic tentacles; cephalic lappets lacking. Neck lobes present, rather symmetrical, undivided. Foot rather small, less than half the diametre of the shell when extended; each side of the epipodium provided in its anterior part with a cluster of three tentacles, the foremost on hardly more than a rounded bulge, the next two tapering and villose, hardly one-tenth of the cephalic tentacles in size; in the posterior part with two more tentacles similar in size and shape to the latter.

Radula (Figs. 20-23) strikingly symmetrical, with broad rachidian having lateral extensions, and moderately long, tapered overhanging cusps; with four pairs of similar lateral teeth, which are elbowed like the rachidian and extend above the shaft of the next tooth; shaft of fifth lateral tooth not in close contact with shaft of fourth lateral tooth; this tooth broad on both sides, with a less prominent cusp than those of the inner lateral teeth or any of the marginal teeth; innermost pair of marginal teeth with short overhanging cusps, followed by four pairs of marginal teeth with longer cusps; outer marginal teeth with longer shafts, overhanging cusps shorter and deeply serrate on sides of the cusps.

The live-collected specimen (Figs. 4-6, 16) reported here (diameter 9.1 mm) has a nearly closed umbilicus and a generally unmodified base, with no indication of the incipient formation of the projecting rim of mature female shells; it is therefore identified as a male specimen. There are immature beach-worn shells of about 10 mm in diameter (Figs. 7-9), which are considered to be female shells, having the beginning of a projecting rim that will form the strong peri-umbilical angulation of the large female shell (Fig. 2). It is evident that male shells are much less frequent among the beach-worn shells. Because the male shell with an operculum is larger than any of the comparable beach-worn shells considered to be male shells, and because the lip is immature, there is no indication from the material at hand as to the possible size reached by male shells. It may be that male shells can reach a size similar to that of female shells. If so, they would differ from female shells in having a rounded umbilical wall, rather than the projecting umbilical rim of female shells.

Both male and female shells seal the umbilicus upon attaining a half-grown diameter of about 10 mm. The female shell then proceeds to form a secondary umbilicus for the brooding cavity. The initial sealing of the umbilicus may help to protect the shell from exposure due to erosion of the apical whorls, which is also avoided in most marine gastropods by shell deposition of a plug from within.

There is variation in the peripheral spination of immature stages. The spination of the live-collected male specimen (Figs. 4-6) is stronger than that of any of the beach-worn shells of similar size, whether identified as male or female.

DISCUSSION

Knowledge of the genus *Anadema* has been slow to develop because the species *A. macandrewii* lives in the sublittoral zone on rocky bottoms exposed to strong surf, where there have apparently been few efforts at collecting by diving due to the exposure, low visibility, and extensive muddy bottoms offshore in relatively shallow water. The single live-collected specimen reported here from the intertidal zone is an unusual record for the species.

Systematic position: There is now no doubt that *Anadema* should be assigned to the family Colloniidae, on the basis of shell and opercular characters, characters of the external anatomy, and the radula. The fine lamellar sculpture had

brought to mind a comparison with Liotiidae, but that is ruled out by the calcareous operculum.

There are many possibilities for opercular morphology in the Colloniidae, just as there are in the Turbinidae (see Vermeij and Williams, 2007). There is no comparative work on the colloniid operculum, but the operculum of *Anadema* is within the range of possible expression for the family. Immature shells of the Mediterranean turbinid species *Bolma rugosa* (Linnaeus, 1767) have a resemblance to *Anadema macandrewii* in having a somewhat similar operculum and a spinose peripheral carination, but mature specimens of *Bolma* are much larger, have a higher profile and an impressed suture, a closed umbilicus and an expansive columellar callus that forms a columellar shield nearly as broad as the aperture. For a review of *Bolma*, see Beu and Ponder (1979). *Anadema macandrewii* differs from all illustrated species of *Bolma* in its low, dome-shaped profile and open umbilicus at maturity.

The keeled early juvenile shells indicate that early sculpture is not evenly bicarinate, which is a defining feature for Turbinidae, according to the restricted definition provided by Hickman and McLean (1990: 55) at the previously recognized subfamily level. Most colloniids have the juvenile shell with even spiral cords, but there are exceptions to that generalization. The keeled early stage brings to mind the recently described *Liotipoma* McLean and Kiel, 2007, in the basal subfamily Petropomatinae, which also has an early keel.

The lack of cephalic lappets is consistent with the assignment to Colloniidae, in which lappets are lacking (Hickman and McLean, 1990). This is in contrast to the Turbinidae, in which the lappets are well-developed (Hickman and McLean, 1990), albeit they are small in the Mediterranean *Bolma rugosa*.

The radular morphology of *Anadema* provides convincing evidence that it is colloniid rather than turbinid because the tooth rows are perfectly symmetrical, and the inner marginals are not greatly enlarged. In turbinids, the asymmetrical tooth row causes the tooth alignment to be skewed, because the large inner laterals must alternate in zipper fashion when the radula is longitudinally folded (as detailed by Hickman and McLean, 1990).

Anadema is highly unusual within Colloniidae for its large size and its keeled early stage. With its maximum shell diameter of 17 mm, it may well be the largest known colloniid. All of the colloniid radulae illustrated by Hickman and McLean (1990) have a secondary flap that projects above the rachidian tooth; the radula of *Anadema* is unusual in not having the secondary flap. In addition, the morphology of the fifth lateral of *Anadema* seems also to be unusual for the family.

Larval brooding: Brooding of larvae within the umbilical cavity has been broadly reported among the Trochoidea (Hickman, 1992: 254). In the Trochidae it is known in *Margarites vorticiferus*, as shown by Lindberg and Dobberteen (1981). In Liotiidae, it has been reported for *Arene socorroensis* by Shasky (1968) and again by Hertz (1998), and for *"Munditia" subquadrata* it has been reported by Burn (1976). In the Colloniidae, it is known in the recently described genus *Liotipoma*, as reported by McLean and Kiel (2007). Its occurrence in *Anadema* is therefore the second known example. In each of these cases, the umbilical rim of the female shell is raised to increase the volume of the umbilical cavity. Such a modification can be the only explanation for the strongly raised umbilical rim of what we interpret as the female shells of *Anadema macandrewii*.

The size reached by the shells of males remains to be discovered; it is possible that mature male shells are smaller than female shells. In support of that possibility, the operculum illustrated here shows the expansion of the final volution that is characteristic of a mature operculum. However, this shell is somewhat immature because the final lip is not thickened. All beach-worn

male shells in the material on hand seem to be immature. The immature male shells are represented by fewer specimens than the larger shells attributed to, for reasons unknown.

ACKNOWLEDGMENTS

We thank Philippe Bouchet and Virginie Heros of the MNHN for arranging the loan of the *Anadema* specimens. Illustrations of shells (from photos by the first author) were prepared in Photoshop by Michelle Schwengel (formerly LACM) and plate preparation for the shells was completed by Ángel Valdés (formerly LACM). Critical-point dried preparation of the live-collected specimen and the SEM views of the head-foot, as well as the SEM illustrations of the radula, were provided by Daniel L. Geiger of the Santa Barbara Museum of Natural History. We thank the reviewers for their suggestions, which led to improvements in the paper.

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A new species of *Mangelia* (Turridae: Mangeliinae) from the Mediterranean Sea

Una nueva especie de *Mangelia* (Turridae: Mangeliinae) del Mediterráneo

Charles CACHIA* and Constantine MIFSUD**

Recibido el 17-VII-2007. Aceptado el 12-III-2008

ABSTRACT

A new species *Mangelia melitensis* nov. sp., from Malta, is introduced and compared with other similar congeneric species.

RESUMEN

Se describe una nueva especie *Mangelia melitensis*, de Malta, y se compara con especies congenéricas de aspecto similar.

KEY WORDS: Mollusca, Conoidea, Turridae, Mangeliinae, *Mangelia* nov. sp., Mediterranean.
PALABRAS CLAVE: Mollusca, Conoidea, Turridae, Mangeliinae, *Mangelia* nov. sp., Mediterráneo.

INTRODUCTION

The genus *Mangelia* is represented in the Mediterranean Sea by about 28 species (CLEMAM 2007). The shells are slender, fusiform in shape, with a sculpture consisting of axial, and often spiral sculpture. The siphonal canal is short and open and the columella is smooth without any processes. The mollusc has a wide foot, long tentacles with eyes situated on the sides of the stalks and at about $^2/_3$ their height, a long siphon and the body is mostly of a transparent white colouration, but sometimes with opaque coloured streaks or blotches, especially on the siphon. The radula consists of hollow marginal teeth, rarely barbed, with an irregular basal swelling (McLEAN, 1971). The animal lacks an operculum. The diet consists mainly of polychaete worms, sometimes larger than the mollusc itself. (C. M. *pers. obs.*)

Certain authors (BOUQUOY, DAUTZENBERG AND DOLLFUS, 1883; POWELL, 1966; VAN AARTSEN AND FEHR DE WAL, 1978) have proposed that the Mediterranean species classification should be separated into two genera, *Mangelia* (Risso, 1826) type species *Mangelia attenuata* (Montagu, 1803) and *Mangiliella* (B.D.D., 1826) type species *Mangiliella multilineolata* (Deshayes, 1836). The proposition is based on the type of development of the protoconch. *Mangelia* has a multi-spiral or planktotrophic type of protoconch, usually consisting of 2 $^1/_2$ or more whorls while *Mangiliella* has a paucispiral or direct type of protoconch consisting of 1 $^1/_2$ to

* 1, Alley 1, St. Catherine street, Qormi QRM, Malta
** 5, Triq ir-Rghajja, Rabat RBT 2486, Malta

2 whorls. Although this arrangement is very convenient for separating the species, BOUCHET (1990) advised against such methods for creating genera and subgenera in this already problematic family.

The Mediterranean species have been dealt with by several authors (NORDSIECK, 1977; VAN AARTSEN AND FEHR DE WAL, 1978; SABELLI, GIANNUZZI-SAVELLI AND BEDULLI, 1990; CACHIA, MIFSUD AND SAMMUT, 2001; GRUPPO MALACOLOGICO LIVORNESE AND GRUPPO MALACOLOGICA ROMAGNOLO, 2005).

During our ongoing research on the marine mollusca which inhabit the coasts of the Maltese Islands, we have come across many specimens of a distinct *Mangelia* species which is new to science. It will be introduced herein.

SYSTEMATICS

Superfamily CONOIDEA Vaught, 1989
Family TURRIDAE Swainson, 1840
Subfamily MANGELIINAE Vaught, 1989
Genus *Mangelia* Risso, 1826

Mangelia melitensis nov. sp. (Figs. 1, 2)

Material studied: All studied material is from the Maltese Islands. Holotype, collection number BMNH 20070312 (H= 6mm, W= 2.5mm), and two paratypes, collection number BMNH 20070313, off Gnejna Bay, in sand and algae from 40 m., x-2006, The Natural History Museum, London. Three paratypes, off Ras il-Wahx, 35 m., ix-1992, collection number MNHN 9988, Muséum National d'Histoire Naturelle, Paris. Three paratypes, off Rdum id-Delli, 50 m., ix-2006, collection number. TAU MO 57001, National Collections of Natural History, Department of Zoology, Tel Aviv University. Four paratypes, off Ras il-Wahx, 25-30 m., ix-1992, and three paratypes, St Thomas Bay, 3-4 m., viii-1987, National Museum of Natural History (Mdina, Malta). Other Paratypes: Salina Bay, 4 m viii-2000, 21 shells; off Rdum id-Delli, 60 m, viii-2006, 5 shells; off Cirkewwa Point, 34 m, viii-1996, 14 shells, in private collection of Charles Cachia.[Coll. No 1185]. Off St. Paul's Bay, 40-50 m., ix-1986, 3 shells; Qammieh, Cumnija, 50 m., viii-1986, 4 shells; St. Thomas Bay, 3-4 m., viii-1987, 11 shells; Bahar ic-Caghaq, beached, i-1991, 5 shells; Gozo Island, Dwejra, Coral cave, in sand, 25 m., 1 shell, 9-vi-2001 (leg. Anthony Sammut); off Golden Bay, 40 m, iii-1991, 9 shells; off Ras il-Wahx, 25-30 m., ix-1992, 31 shells off Rdum id-Delli, 50 m., ix-2006, 9 shells, in private collection of Constantine Mifsud [coll. No. M1601]. Off Ras il-Wahx, 25-30 m., ix-1992, 2 shells, in private collection of Charles Sammut. Salina Bay, 4 m., viii-1998, 2 shells (C. Cachia leg.), in private collection of Gert Lindner.
Type locality: Gnejna Bay, Maltese Islands.
Etymology: Named after the type locality.

Description: Shell small, rather fragile, fusiform, typical of the genus. Protoconch consists of 2 $^1/_2$, rounded, transparent white, glassy whorls, the last with a few small, close-set axial riblets crossed by spiral micro-striae. Teleoconch consists of up to four whorls which are subangulated at their adapical third and curving regularly towards the suture. Sculpture of 8-9 narrow, flexuous, slightly opisthocline, axial ribs which continue to the base. Their interspaces are about twice as wide. The whole surface of the shell is covered with dense micro-spiral striae of about the same thickness and close-set axial growth lines, producing an iridescent pattern. There are about 45-50 of these micro-spiral striae at the penultimate whorl. There are also 5-6 well spaced, thicker spiral chords at the base of the shell, near the siphonal canal. Aperture about half height of shell. Outer lip sharp, thin and fragile, thickened internally, with its topmost part clearly curved. Lip varix present in some specimens. Sinus shallow. Columella smooth.

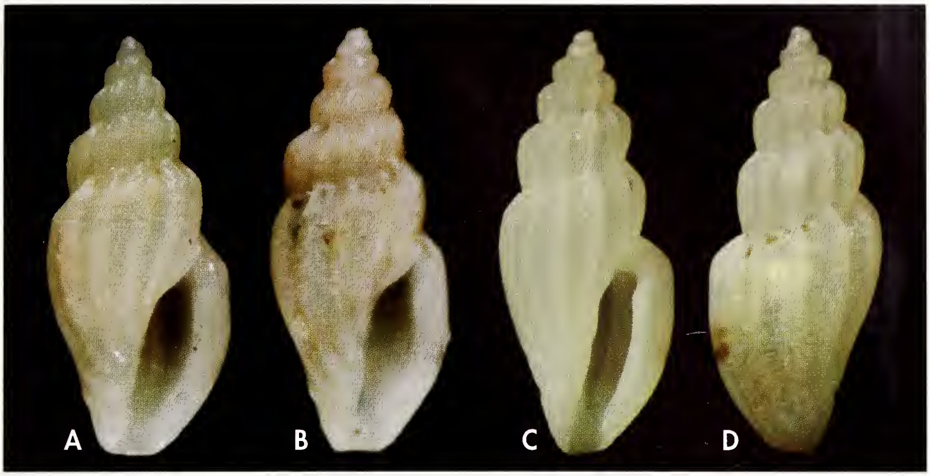

Figure 1. *Mangelia melitensis* nov. sp., shells. A: holotype from off Gnejna Bay, in sand and algae, 40 m (height 6 mm); B: paratype from the type locality (height 6 mm); C, D: paratype from off Ras il–Wahx, 25-30 m (height 6.1 mm).

Figura 1. Mangelia melitensis *nov. sp., conchas. A: holotipo, frente a Gnejna Bay, en arena y algas, 40 m (altura 6 mm); B: paratipo de la localidad tipo (altura 6 mm); C, D: paratipo, frente a Ras il–Wahx, 25-30 m (altura 6,1 mm).*

Siphonal canal short and wide. The shell colour is white or beige. Rarely, some specimens are decorated with four, faint, brownish spiral bands or with tiny, brown sub-sutural blotches on the penultimate whorl, while others have a dark blotch at the middle of the exterior of the outer lip. A single specimen is completely brown.

The animal is transparent white with large black eyes at about two-thirds of the height of the tentacle stems. The foot has opaque white spots, while the siphon has small opaque yellowish spots. There is no operculum.

The species is found near or in *Posidonia oceanica* (Linnaeus) Delile, substratum at depths of 3 to 50 metres.

DISCUSSION

M. melitensis nov. sp. had already been introduced as *Mangelia* sp. A. in CACHIA *ET AL.* (2001). It differs from all the other Mediterranean forms of the *M. unifasciata* (Deshayes, 1835) complex, to which it is very similar, by the lack of bold spiral cords on its whorls. It is similar in this respect to *M. costulata* Risso, 1826 [= *M. smithii* (Forbes, 1840)], but in that species the spiral striae are fewer, flatter, much bolder, and continuous, not crossed by growth lines, while their interspaces are deeply incised. *Mangelia costulata* never forms a thickened rib on the aperture, unlike the present species: Moreover, in *M. costulata* the last protoconch whorl has a bold reticulate type of sculpture, whilst in *M. melitensis* nov. sp. this whorl has only close-set flexuous axials with spiral micro-striae. *M. costulata* usually has a continuous wide brown band on the ultimate whorl and the animal has a bright orange spotted siphon.

Mangelia melitensis nov. sp., also offers similarities to *Mangelia costata* (Donovan, 1804). In that species however the whorls are very evenly convex not somewhat subangulated as

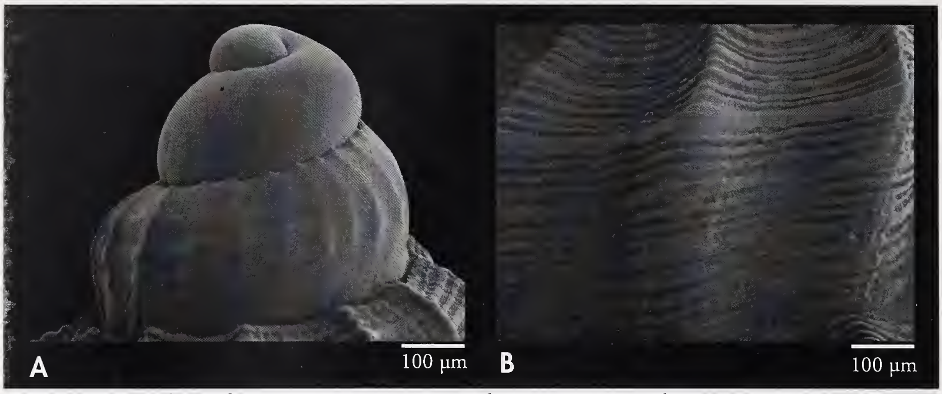

Figure 2. *Mangelia melitensis* nov. sp., scanning electron micrographs, same paratype as Figures 1C-D. A: protoconch; B: detail of the sculpture on a spire whorl.

Figure 2. Mangelia melitensis *nov. sp., vistas en microscopía electrónica, mismo paratipo que las Figura 1C-D. A: protoconcha; B: detalle de la escultura en una vuelta de la espira.*

in *Mangelia melitensis* nov. sp. The shell is also smaller, rather glossy, differently coloured, of a more fusiform aspect and with a slightly different protoconch. The animal is completely white.

Distribution: The Maltese Islands. The authors have not come across any specimens of *M. melitensis* nov. sp. from any other Mediterranean locality.

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Catálogo de los bivalvos marinos del sector central del Golfo de Valencia (España)

Checklist of the marine bivalves in the central sector of the Gulf of Valencia (Spain)

Jorge C. TAMAYO GOYA*

Recibido el 12-II-2007. Aceptado el 31-III-2008

RESUMEN

Se presenta una lista con 184 especies de Bivalvos marinos citados en la literatura y recolectados por el autor entre 1998 y 2008, en la costa del Golfo de Valencia, sector central: 39° 42′ N, 0° 12′ W (Playa de Canet de Berenguer, Sagunto) – 38° 55′ N, 0° 03′ W (Playa de Oliva), Mediterráneo occidental. *Gari fervensis* se cita por primera vez en la zona y se confirma la existencia de poblaciones establecidas de *Eastonia rugosa, Fulvia fragilis* y *Lentidium mediterraneum*.

ABSTRACT

A list is presented with 184 species of marine Bivalves cited in the literature or collected by the author between 1998 and 2007, along the coast of Gulf of Valencia, central sector: 39° 42′ N, 0° 12′ W (Playa de Canet de Berenguer, Sagunto) – 38° 55′ N, 0° 03′ W (Playa de Oliva), Western Mediterranean. *Gari fervensis* is cited for the first time in the area and the occurrence of established populations is confirmed for *Eastonia rugosa, Fulvia fragilis* and *Lentidium mediterraneum*.

PALABRAS CLAVE: Catálogo, moluscos, bivalvos, Golfo de Valencia, Mar Mediterráneo.
KEY WORDS: Checklist, molluscs, bivalves, Gulf of Valencia, Mediterranean Sea.

INTRODUCCIÓN

En este trabajo se presenta una actualización de la lista faunística de moluscos bivalvos de la Bahía de Valencia. Estos complementan un catálogo recientemente publicado (OLIVER BALDOVÍ, 2007) donde se aporta una actualización de Gasterópodos marinos testáceos de la zona sur del Golfo de Valencia.

La gran mayoría de las conchas recolectadas son explayadas, por lo que no se puede indicar su hábitat originario. En mucha menor medida, se han obtenido buceando a pulmón-con tubo (entre -2 y -3 m) o recogidas por una embarcación "marisquera" faenando a escasos metros de la costa (zona infralitoral). Las recogidas de muestras se han ido realizando a lo largo de todas las estaciones entre los años 1998 y 2008 y no se ha seguido una metodología concreta.

Los sustratos sedimentarios que constituyen el hábitat de las comunidades presentes en el piso infralitoral son, las correspondientes a: arenas finas

* C/Polo y Peyrolón, 37, izda 16, 46201, Valencia.

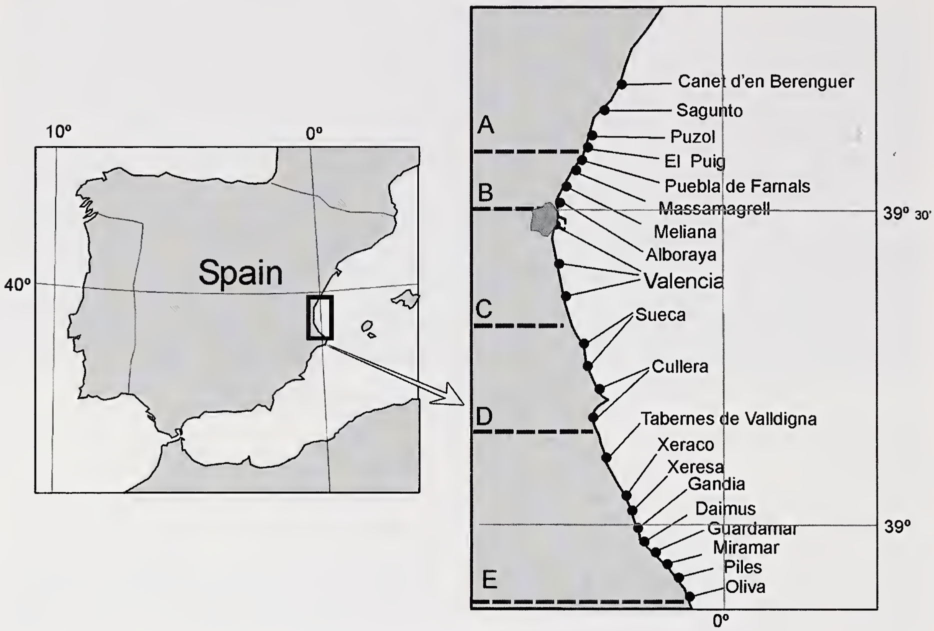

Figura 1. Localidades de muestreo en el Golfo de Valencia.
Figure 1. Sampling sites in Gulf of Valencia.

superficiales, arenas finas bien calibradas (entre -2/-3 m. y -20/-25 m.), arenas finas fangosas (entre -20/-25 m. y -35/-40 m.), arenas con proporciones pequeñas de finos (<15%) (consideradas como transición entre ambos sustratos) y los fondos detríticos.

El sustrato rocoso está presente en mucha menor medida, lo mismo que las praderas de *Posidonia oceanica* (en mucha mayor proporción de mata muerta que degradada, y que suele extenderse en una distribución batimétrica entre -5 m y -20 m), así como la *Cymodocea nodosa* y la *Caulerpa prolifera*. Las arenas gruesas y gravillas, ocupan franjas a profundidades variables y sujetas a corrientes marinas.

A continuación en profundidad, en la plataforma continental, está el piso circalitoral (entre -40 m. y -100 m.), de escasa pendiente, en el que están presentes los fondos detríticos costeros. Los fondos fangosos terrígenos (a partir de -100/-150 m.) se extienden por zonas muy amplias del fondo marino.

El litoral en estudio, eminentemente sedimentario, se caracteriza por la sucesión casi continuada de playas de arena fina, sólo interrumpidas por las instalaciones portuarias, las desembocaduras fluviales (áreas de fondos fangosos) y el Cabo de Cullera (acantilado mediano)

Las poblaciones en cuyas playas se han efectuado la recogida de ejemplares son colindantes entre sí y han sido agrupadas, de norte a sur, en las siguientes subzonas (Fig. 1), siendo la B y la D en donde mayor número de muestreos se han realizado:

A: (Canet d'En Berenguer), Sagunto, Puzol y El Puig. Predominan las arenas finas bien calibradas, en mucha menor medida las de arenas finas fangosas y las extensiones de mata muerta de *Posidonia*. El puerto de Sagunto y el puerto deportivo de Canet de Berenguer, la planta siderúrgica de Sagunto, el emisario de Canet de Berenguer, y la desembocadura del río Palancia, son agentes determinantes en la configuración sedimentaria de esta zona del litoral.

B: Puebla de Farnals, Massamagrell, Meliana, Alboraya y las playas al norte de Valencia. Las arenas finas fangosas predominan sobre las arenas finas bien calibradas. Es de mencionar el sustrato rocoso frente al Puerto de Valencia y las extensiones de mata muerta de *Posidonia*, en mayor superficie que las de la subzona A. El puerto deportivo de Port sa Playa, el Barranco de Carraixet y el emisario de Vera (al norte del Puerto de Valencia), son los agentes de esta subzona.

C: Playas al sur de Valencia. Hay mucho mayor predominio de las arenas finas bien calibradas sobre las arenas finas fangosas. El Puerto de Valencia, la desembocadura del río Turia, el emisario del sur del Puerto y las Golas del Pujol y de El Perellonet (provenientes de La Albufera), son los agentes a destacar.

D: Sueca y Cullera . Es la subzona con mayor proporción de arenas finas bien calibradas y con menor de finas fangosas en el área de estudio. A reseñar también, la presencia de mata muerta de *Posidonia* en el afloramiento rocoso frente a Cullera. Cabe mencionar en esta subzona, la desembocadura del Jucar y las Golas de El Perelló y la del Estany.

E: Tavernes de la Valldigna, Xeraco, Xeresa, Gandía, Daimuz, Guardamar, Miramar, Piles y Oliva.Las arenas finas fangosas predominan sobre las finas bien calibradas. Frente a Gandía existe otro enclave rocoso con presencia de *Posidonia*. Los puertos de Gandía y Oliva, constituyen lo más destacable como agentes determinantes.

SISTEMÁTICA

En la Tabla I se presenta el listado de especies encontradas en el área de estudio, junto con el número de especímenes encontrados, sus sectores de distribución y citas bibliográficas. Esta lista ha sido ordenada de acuerdo con la clasificación propuesta por CLEMAM. Check List of European Marine Mollusca: <http:// www.somali-asso.fr/clemam>.

DISCUSIÓN

Glycymeris violacescens (Lamarck, 1819)

Es una especie muy presente en gran parte del litoral de Valencia que con frecuencia se muestra con un polimorfismo y policromía muy característicos (Fig. 2), predominando el contorno de la concha menos subcuadrangular, muchas veces más oblicua; el color gris negruzco-azulado, principalmente en la mitad superior y umbo, combinado con los colores tierra (beige y marrón) y con mucha mayor superficie de mancha en el interior de la valva; generalmente, los umbos más separados y con mayor área cardinal; cohabitando en proporciones similares con los ejemplares más comunes-tipo, más frecuentemente divulgados (Fig. 3).

Fulvia fragilis (Forsskal *in* Niehbur, 1775)

Se confirma (Fig. 4) la presencia en la zona de esta especie, previamente citada en Cullera por Zenetos et al.(2004) a partir de ejemplares recolectados en 1991. Ello indica que esta especie está formando poblaciones perennes en la zona, al igual que sucede en otras partes del Mediterráneo (CROCETTA, 2005; VARDALA-THEODOROU , 1999).

Eastonia rugosa (Helbling, 1779)

Especie presente ocasionalmente en este sector del Golfo de Valencia, salvo en la subzona B en la que si es habitual hallarla. En la playa de Meliana (subzona B) es donde se concentra la gran mayoría de los individuos de esta especie encontrados en esta zona del litoral (Fig. 5). Decenas y decenas de conchas de individuos jóvenes y adultos son depositadas todos los años en esta playa. En esta subzona B, también se localiza una importante concentración de ejemplares, aunque en menor medida, de *Lutraria magna* (da Costa, 1778) y *Venericardia antiquata* (Linné, 1758). Es de notar que esta especie manifiesta una tendencia a ampliar su extensión en el Mediterráneo, siendo recientemente observada en abundancia en las costas italianas en localidades donde no se conocía anteriormente (LA VALLE, VANI, LIBONI Y SMRIGLIO, 2007).

Tabla I. Listado de especies encontradas en el área de estudio. Ej: concha recolectada explayada; Ej*: entre 1 y 3 ejemplares recolectados; Ej*̲: entre 1 y 3 ejemplares recolectados, deteriorados; L: especie presente en la colección de referencia del laboratorio de Biología Marina de la Universidad de Valencia (1982-1989, García Carrascosa, no publicado) o citada en la bibliografía reseñada, sin ejemplar recolectado por el autor. Las letras (ABCDE) corresponden a los sectores de la Figura 1 en los que se han recolectado ejemplares. Las referencias a las citas se indican como sigue: (1) Colección de referencia del laboratorio de la Universidad de Valencia; (2) Aparici Seguer, Rowland, Taylor y García Carrascosa, 1996; (3) Bonnin y Rodríguez Babio, 1990; (4) Costa, García Carrascosa, Monzó, Peris, Stubing y Valero, 1984; (5) Generalitat Valenciana, Conselleria de Agricultura y Medio Ambiente, 1994-1997; (6) Giner Ponce, 1989; (7) Hidalgo, 1917; (8) Montero Agüera, 1971; (9) Ramón Herrero, 1993; (10) Roselló, 1910; (11) Sánchez Diana, 1980. Los nombres subrayados corresponden a las especies que están comentadas en este trabajo.

Table I. List of the species found in the studied area. Ej: shell collected on the beach; Ej: 1 to 3 specimens found; Ej*̲: 1 to 3 specimens found, damaged; L: species found in the reference collection deposited in the Marine Biology laboratory of the University of Valencia (1982-1989, García Carrascosa, unpublished data) or cited in literature, no specimens collected by the author. Letters (ABCDE) refer to Figure 1 sectors. Literature cited as follows: (1) reference collection deposited in the laboratory of the University of Valencia; (2) Aparici Seguer, Rowland, Taylor and García Carrascosa, 1996; (3) Bonnin y Rodríguez Babio, 1990; (4) Costa, García Carrascosa, Monzó, Peris, Stubing and Valero, 1984; (5) Generalitat Valenciana, Conselleria de Agricultura y Medio Ambiente, 1994-1997; (6) Giner Ponce, 1989; (7) Hidalgo, 1917; (8) Montero Agüera, 1971; (9) Ramón Herrero, 1993; (10) Roselló, 1910; (11) Sánchez Diana, 1980. Underlined names are discussed in this paper.*

Especie	Especimenes	Localización	Referencias
Familia SOLEMYIDAE			
Solemya togata (Poli, 1791)	L		3, 7, 8, 10, 11
Familia NUCULIDAE			
Nucula nitidosa Winckworth, 1930	Ej	BCD	3, 5, 7, 8, 10, 11
Nucula nucleus (Linné, 1758)	Ej	ABD	1, 3, 5, 6, 7, 8, 10, 11
Nucula sulcata Bronn, 1831	L		1, 2, 3, 5, 6, 7, 8, 11
Familia NUCULANIDAE			
Nuculana pella (Linné, 1767)	Ej*	ABCDE	2, 3, 5, 6, 7, 8, 10, 11
Saccella commutata (Philippi, 1844)	L		3, 5, 7, 8, 10, 11
Familia ARCIDAE			
Arca noae Linné, 1758	Ej	ABCDE	2, 3, 5, 6, 7, 8, 10, 11
Arca Terragona Poli, 1795	L		1, 3, 6, 7, 8, 10, 11
Barbatia barbata (Linné, 1758)	Ej	ABCDE	3, 8, 10, 11
Barbatia clathrata (Defrance, 1816)	L		3,
Anadara corbuloides (Monterosato, 1880)	Ej*	B	3, 7, 8, 10, 11
Anadara polii (Mayer, 1868)	Ej*	B	3, 7, 8, 10, 11
Bathyarca pectunculoides (Scacchi,1835)	L		3, 7, 8, 11
Bathyarca philippiana (Nyst, 1848)	L		3, 8
Familia NOETIIDAE			
Striarca lactea (Linné, 1758)	Ej	ABCDE	1, 2, 3, 5, 6, 7, 8, 10, 11
Familia GLYCYMERIDAE			
Glycymeris bimaculata (Poli, 1795)	L		3, 5, 7, 8, 10, 11
Glycymeris glycymeris (Linné, 1758)	Ej*	D	1, 2, 3, 4, 6, 7, 10, 11
<u>*Glycymeris violascescens* (Lamarck, 1819)</u>	Ej	ABCDE	1, 3, 5, 6, 7, 8, 10, 11
Familia MYTILIDAE			
Mytilus edulis Linné, 1758	Ej	ABCDE	3, 7, 8, 10, 11

Tabla I. Continuación.
Table I. Continuation.

Especie	Especimenes	Localización	Referencias
Mytilus galloprovincialis Lamarck, 1819	Ej	ABCDE	1, 2, 3, 4, 5
Mytilaster minimus (Poli, 1795)	Ej*	D	1, 3, 7, 8, 10, 11
Gregariella petagnae (Scacchi, 1832)	Ej	DE	1, 2, 3, 8, 10, 11
Musculus costalatus (Risso, 1826)	Ej	B	1, 3, 6, 7, 8, 10, 11
Musculus subpictus (Cantraire, 1835)	Ej*	B	1, 2, 3, 8, 10, 11
Lithophaga lithophaga (Linné, 1758)	Ej	ABCDE	1, 3, 4, 5, 6, 7, 8, 10, 11
Myoforceps aristatus (Dillwyn, 1817)	L		3, 7, 8, 10, 11
Modiolus adriaticus (Lamarck, 1819)	Ej	BD	3, 5, 7, 8, 10, 11
Modiolus martorelli (Hidalgo, 1878)	L		3, 4, 7, 8, 10, 11
Modiolus barbatus (Linné, 1758)	Ej	ABCDE	1, 3, 5, 6, 7, 8, 10, 11
Amygdalum agglutinans (Cantraine, 1835)	Ej	D	5
Modiolula phaseolina (Phillipi, 1844)	L		3, 7, 8, 10, 11
Familia PINNIDAE			
Pinna nobilis Linné, 1758	L		3, 4, 7, 8, 10, 11
Pinna rudis Linné, 1758	L		3, 8, 11
Atrina pectinata (Linné, 1767)	Ej	CDE	3, 7, 10, 11
Familia PTERIIDAE			
Pteria hirundo (Linné, 1758)	Ej	C	3, 4, 5, 7, 8, 10, 11
Familia PECTINIDAE			
Pecten jacobeus (Linné, 1758)	Ej	ABDE	3, 4, 5, 7, 8, 10, 11
Pecten maximus (Linné, 1758)	L		3, 7, 8, 11
Aequipecten opercularis (Linné, 1758)	Ej	DE	3, 5, 7, 8, 10, 11
Lissopecten hyalinus (Poli, 1795)	Ej	ACD	3, 7, 8, 10, 11
Palliolum incomparabile (Risso, 1826)	L		3, 7, 8, 10, 11
Pseudamussium clavatum (Poli, 1795)	L		3, 7, 8, 10, 11
Hyalopecten similis (Laskey, 1811)	L		3, 7, 8, 10
Propeamussium fenestratum (Forbes, 1844)	L		3,
Chlamys flexuosa (Poli, 1795)	Ej	BCD	3, 4, 7, 8, 10, 11
Chlamys glabra Linné, 1758)	Ej	BDE	3, 5, 7, 8, 10, 11
Chlamys pesfelis (Linné, 1758)	Ej	BD	3, 7, 8, 10, 11
Chlamys multistrata (Poli, 1795)	Ej	BCDE	3, 5, 8, 11
Chlamys varia (Linné, 1758)	Ej	ABCDE	3, 5, 6, 7, 8, 10, 11
Familia Spondylidae			
Spondylus gaederopus Linné, 1758	Ej	ABCD	3, 5, 7, 8, 10, 11
Familia ANOMIIDAE			
Anomia ephippium Linné, 1758	Ej	ABCDE	2, 3, 5, 7, 8, 10, 11
Pododesmus patelliformis (Linné, 1761)	L		3
Familia LIMIDAE			
Lima lima (Linné, 1758)	Ej	ABCD	1, 3, 5, 6, 7, 8, 10, 11
Limaria hians (Gmelin, 1791)	Ej	ABCDE	1, 3, 4, 5, 6, 7, 8, 10, 11
Limaria tuberculata Olivi, 1792	Ej	BCDE	1, 3, 4, 6, 7, 8, 10, 11
Limea loscombii (Sowerby G.B., 1824)	L		3, 4, 5
Limatula subauriculata (Montagu, 1808)	L		3, 7, 8, 10, 11
Notolimea crassa (Forbes, 1844)	L		3,
Familia OSTREIDAE			
Ostrea edulis Linné, 1758	Ej	ABDE	3, 5, 7, 8, 11
Crassostrea gigas (Thunberg, 1793)	L		3, 8, 11

Tabla I. Continuación.
Table I. Continuation.

Especie	Especimenes	Localización	Referencias
Ostreola stentina (Payraudeau, 1826)	Ej	ABCDE	1, 3, 8
Familia LUCINIDAE			
Ctena decussata (Costa O.G., 1829)	Ej	BCD	1, 3, 6, 7, 10, 11
Loripes lacteus (Linné, 1758)	Ej	ABCDE	1, 2, 3, 5, 6, 7, 8, 9, 10, 11
Lucinella divaricata (Linné, 1758)	Ej	BD	1, 2, 3, 6, 7, 8, 10, 11
Anodontia fragilis (Philippi, 1836)	L		1, 3, 7, 8, 10, 11
Myrtea spinifera (Montagu, 1803)	L		1, 3, 5, 7, 8, 10, 11
Lucinoma borealis (Linné, 1767)	Ej	DE	3
Familia THYASIRIDAE			
Thyasira flexuosa (Montagu, 1803)	L		3, 11
Familia UNGULINIDAE			
Diplodonta rotundata (Montagu, 1803)	Ej	DE	1, 3, 7, 8, 10, 11
Familia CHAMIDAE			
Chama gryphoides Linné, 1758	Ej	ABCDE	1, 2, 3, 5, 6, 7, 8, 10, 11
Pseudochama gryphina (Lamarck, 1819)	Ej	ABCD	3, 4, 7, 8, 10, 11
Familia GALEOMMATIDAE			
Galeomma turtoni Sowerby GB in Turton, 1825	L		1, 2, 3, 6, 7, 8, 10, 11
Familia KELLIIDAE			
Kellia suborbicularis (Montagu, 1803)	L		3,
Bornia geoffroyi (Payraudeau, 1826)	L		3, 8, 10, 11
Bornia sebetia (Costa O.G., 1829)	L		3, 7, 10
Familia LASAEIDAE			
Lasaea rubra (Montagu, 1803)	L		3
Semierycina nitida (Turton, 1822)	L		3
Familia MONTACUTIDAE			
Montacuta substriata (Montagu, 1808)	L		3
Tellimya ferruginosa (Montagu, 1808)	L		3, 7, 8, 10, 11
Mysella bidentata (Montagu, 1803)	L		1, 3, 7, 8, 10, 11
Familia CARDITIDAE			
Cardita calyculata (Linné, 1758)	L		3, 8, 10, 11
Glans aculeata (Poli, 1795)	L		3, 8, 10, 11
Glans trapezia (Linné, 1767)	Ej	ABCD	1, 3, 5, 6, 7, 8, 10, 11
Venericardia antiquata (Linné, 1758)	Ej	BD	3, 5, 6, 7, 8, 10, 11
Familia ASTARTIDAE			
Astarte fusca (Poli, 1795)	L		3, 7, 8, 10, 11
Astarte sulcata (da Costa, 1778)	L		3,
Digitaria digitaria (Linné, 1758)	L		3, 8, 10, 11
Goodallia triangularis (Montagu, 1803)	L		3, 7, 8, 10, 11
Familia CARDIIDAE			
Acanthocardia aculeata (Linné, 1758)	Ej	ABCDE	3, 5, 7, 8, 10, 11
Acanthocardia deshayesii (Payraudeau, 1826)	L		3, 7, 8, 10, 11
Acanthocardia echinata (Linné, 1758)	Ej	ABCDE	3, 5, 7, 8, 10, 11
Acanthocardia paucicostata (Sowerby G.B. II, 1841)	Ej	ABDE	3, 5, 7, 8, 10, 11
Acanthocardia spinosa (Solander, 1786)	L		3, 5, 7, 10, 11
Acanthocardia tuberculata (Linné, 1758)	Ej	ABCDE	2, 3, 4, 6, 7, 9, 10, 11
Parvicardium exiguum (Gmelin, 1791)	Ej	DE	1, 3, 7, 8, 10, 11
Parvicardium minimum (Philippi, 1836)	L		1, 3, 7, 8, 10, 11

Tabla I. Continuación.
Table I. Continuation.

Especie	Especimenes	Localización	Referencias
Parvicardium scabrum (Philippi, 1844)	L		3, 5, 7, 8, 10, 11
Papillicardium papillosum (Poli, 1791)	Ej	ABCDE	1, 2, 3, 5, 6, 7, 8, 10, 11
Laevicardium crassum (Gmelin, 1791)	Ej*	BD	3, 5, 11
Laevicardium oblongum (Gmelin, 1791)	Ej	ABDE	3, 4, 5, 7, 8, 10, 11
Cerastoderma edule (Linné, 1758)	Ej	ABCDE	3, 5, 6, 7, 8, 11
Cerastoderma glaucum (Poiret, 1789)	Ej	ABCDE	1, 3, 5, 10
Fulvia fragilis (Forskal, 1775)	Ej	DE	
Familia MACTRIDAE			
Mactra glauca Born, 1778	Ej*	D	3, 7, 8, 10, 11
Mactra stultorum (Linné, 1758)	Ej	ABCDE	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Spisula subtruncata (da Costa, 1778)	Ej	ABCDE	2, 3, 5, 6, 8, 9, 10, 11
Lutraria angustior Philippi, 1844	Ej	BD	
Lutraria lutraria (Linné, 1758)	Ej	BCD	3, 8, 10, 11
Lutraria magna (da Costa, 1778)	Ej	BCD	3, 7, 8, 10, 11
Eastonia rugosa (Helbling, 1779)	Ej	BCD	3, 8, 11
Familia MESODESMATIDAE			
Donacilla cornea (Poli, 1791)	L		3
Familia SOLENIDAE			
Solen marginatus Pulteney, 1799	Ej	ABD	3, 4, 7, 8, 10, 11
Familia PHARIDAE			
Pharus legumen (Linné, 1758)	Ej	ABCDE	3, 4, 5, 6, 7, 8, 9, 10, 11
Ensis arcuatus (Jeffreys, 1865)	L		3
Ensis ensis (Linné, 1758)	Ej	ABCDE	3, 5, 7, 8, 10, 11
Ensis minor (Chenu, 1843)	L		3
Ensis siliqua (Linné, 1758)	Ej	ABCDE	4, 7, 8, 10, 11
Phaxas pellucidus (Pennant, 1777)	L		2, 5
Familia TELLINIDAE			
Tellina distorta Poli, 1791	L		1, 3, 5, 7, 8, 10, 11
Tellina donacina Linné, 1758	Ej*	B	2, 3, 4, 5, 6, 7, 8, 11
Tellina fabula Gmelin, 1791	Ej*	BD	1, 2, 3, 4, 6, 9, 10
Tellina incarnata Linné, 1758	Ej	ABCDE	1, 2, 3, 5, 6, 7, 8, 10, 11
Tellina nitida Poli, 1791	Ej	ABCDE	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Tellina planata Linné, 1758	Ej	ABCDE	1, 2, 3, 4, 5, 7, 8, 10, 11
Tellina pulchella Lamarck, 1818	Ej	ABCDE	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Tellina serrata Brocchi, 1814	L		3, 5, 7, 8, 10, 11
Tellina tenuis da Costa, 1778	Ej	ABCDE	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Arcopagia balaustina (Linné, 1758)	L		3, 5, 6, 7, 8, 10, 11
Macoma cumana (Costa O.G., 1829)	Ej	ABCDE	1, 2, 3, 5, 6, 7, 8, 9, 10, 11
Gastrana fragilis (Linné, 1758)	Ej	BDE	1, 3, 7, 8, 10, 11
Familia DONACIDAE			
Donax semistriatus Poli, 1795	Ej	ABCDE	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Donax trunculus Linné, 1758	Ej	ABCDE	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Capsella variegatus (Gmelin, 1791)	L		1, 3, 6
Capsella venustus Poli, 1795	Ej*	D	1, 3, 5, 6
Familia PSAMMOBIIDAE			
Gari costulata (Turton, 1822)	L		1, 3, 4
Gari depressa (Pennant, 1777)	Ej	BD	3, 5, 6, 7, 8, 10, 11

Tabla I. Continuación.
Table I. Continuation.

Especie	Especimenes	Localización	Referencias
Gari fervensis (Gmelin, 1791)	Ej	BD	
Familia SEMELIDAE			
Scrobicularia cottardi (Payraudeau, 1826)	L		3, 7, 8, 10, 11
Scrobicularia plana (da Costa, 1778)	L		3, 5, 8, 10, 11
Familia SEMELIDAE			
Abra alba (W. Wood, 1802)	Ej	BD	2, 3, 5, 7, 8, 10, 11
Abra prismatica (Montagu, 1808)	Ej*	D	1, 3, 4, 7, 8, 10, 11
Abra segmentum (Récluz, 1843)	Ej	BD	3, 7, 8, 10, 11
Abra tenuis (Montagu, 1803)	Ej	B	2, 3, 7, 8, 10, 11
Familia SOLECURTIDAE			
Solecurtus scopula (Turton, 1822)	Ej*	D	3, 7, 8, 10, 11
Solecurtus strigilatus (Linné, 1758)	Ej	BCD	3, 7, 8, 10, 11
Azorinus chamasolen (da Costa, 1778)	Ej	CDE	3, 5, 10, 11
Familia KELLIELLIDAE			
Kelliella abyssicola (Forbes, 1844)	L		3
Familia TRAPEZIIDAE			
Coralliophaga lithophagella (Lamarck, 1819)	L		3
Familia GLOSSIDAE			
Glossus humanus (Linné, 1758)	Ej*	D	3, 7, 8, 10, 11
Familia VENERIDAE			
Venus casina Linné, 1758	Ej	BCD	3, 4, 5, 6, 7, 8, 10, 11
Venus nux Gmelin, 1791	Ej	BCD	3, 7, 8, 10, 11
Venus verrucosa Linné, 1758	Ej	ABCDE	3, 4, 5, 6, 7, 10, 11
Chamelea gallina (Linné, 1758)	Ej	ABCDE	2, 3, 5, 6, 7, 8, 9, 10, 11
Clausinella fasciata (da Costa, 1778)	L		2, 3, 5, 11
Timoclea ovata (Pennant, 1777)	L		1, 3, 5, 8, 10, 11
Gouldia minima (Montagu, 1803)	Ej	BD	1, 3, 5, 6, 7, 8, 10, 11
Dosinia exoleta (Linné, 1758)	Ej	BD	1, 3, 4, 5, 6, 11
Dosinia lupinus (Linné, 1758)	Ej	ABCDE	1, 2, 3, 5, 6, 7, 8, 9, 10, 11
Pitar rudis (Poli, 1795)	Ej	ABCDE	1, 2, 3, 5, 8, 10
Callista chione (Linné, 1758)	Ej	ABDE	3, 5, 7, 8, 10, 11
Ruditapes decussatus (Linné, 1758)	Ej	BCDE	1, 3, 7, 8, 10, 11
Tapes rhomboides (Pennant, 1777)	Ej	BD	3, 7, 8, 10, 11
Irus irus (Linné, 1758)	Ej	ABCD	1, 3, 7, 8, 10, 11
Venerupis aurea	Ej	ABCDE	1, 3, 4, 5, 6, 7, 8, 9, 10, 11
Venerupis corrugata (Gmelin, 1791)	Ej	AD	1, 2, 3, 6, 7, 8, 10, 11
Familia PETRICOLIDAE			
Petricola lithophaga (Philippson, 1788)	Ej	BCD	1, 2, 3, 5, 7, 8, 10, 11
Lajonkairia lajonkairii (Payraudeau, 1826)	Ej	BCD	3, 5, 10
Petricola substriata (Montagu, 1808)	L		3, 10
Mysia undata (Pennant, 1777)	Ej	DE	2, 3, 8, 10, 11
Familia CORBULIDAE			
Corbula gibba (Olivi, 1792)	Ej*	BCD	2, 3, 5, 6, 7, 8, 9, 10, 11
Lentidium mediterraneum (Costa O.G., 1829)	Ej	BCD	1, 2, 3, 4, 6, 8, 10, 11
Familia GASTROCHAENIDAE			
Gastrochaena dubia (Pennant, 1777)	L		1, 2, 3, 5, 6, 7, 8, 10, 11

Tabla I. Continuación.
Table I. Continuation.

Especie	Especimenes	Localización	Referencias
Familia HIATELLIDAE			
Hiatella arctica (Linné, 1767)	L		1, 2, 3, 5, 6, 7, 8, 10, 11
Hiatella rugosa (Linné, 1767)	L		3, 5
Familia PHOLADIDAE			
Pholas dactylus Linné, 1758	Ej	BCDE	3, 10
Barnea candida (Linné, 1758)	Ej	BCD	3
Familia THRACIIDAE			
Thracia papyracea (Poli, 1791)	Ej	BCDE	1, 2, 3, 6, 7, 8, 9, 10, 11
Thracia pubescens (Pulteney, 1799)	Ej	BCD	3, 5, 7, 8, 10, 11
Familia PANDORIDAE			
Pandora inaequivalvis (Linné, 1758)	Ej	ABCDE	1, 2, 3, 5, 6, 7, 8, 9, 10, 11
Pandora pinna (Montagu, 1803)	L		3, 5, 11
Familia LYONSIIDAE			
Lyonsia norwegica (Gmelin, 1791)	Ej*	D	3, 5
Familia POROMYIDAE			
Poromya granulata (Nyst & Westendorp, 1839)	L		3, 8, 10, 11
Familia CUSPIDARIIDAE			
Cuspidaria cuspidata (Olivi, 1792)	L		3, 8, 10, 11
Cuspidaria rostrata (Spengler, 1793)	L		3, 8, 10, 11
Cardiomya costellata (Deshayes, 1835)	L		3, 8, 10, 11

Gari fervensis (Gmelin, 1791)
Esta epecie tampoco está citada en los trabajos anteriormente relacionados, pero también habita de forma perenne en la Bahía de Valencia (Fig. 6). No es frecuente su presencia en el litoral examinado, aunque tampoco lo es de forma ocasional. Se pueden localizar, año tras año, individuos jóvenes y adultos en las mismos emplazamientos y con similar frecuencia y abundancia que su congénere, *Gari depressa* (Pennant, 1777).

Lentidium mediterraneum (Costa O.G., 1829)
Diversos trabajos escalonados en el tiempo, (recientes: APARICI *ET AL.*, 1989; GARCÍA CARRASCOSA, 1988; y menos reciente, MONTERO AGÜERA, 1971) además de los ejemplares localizados por el autor en Puebla de Farnals, Valencia, Sueca y Cullera, entre 2004 y 2007 (Fig. 7), evidencian la presencia no de forma esporádica, de esta especie a lo largo de todo el litoral en estudio.

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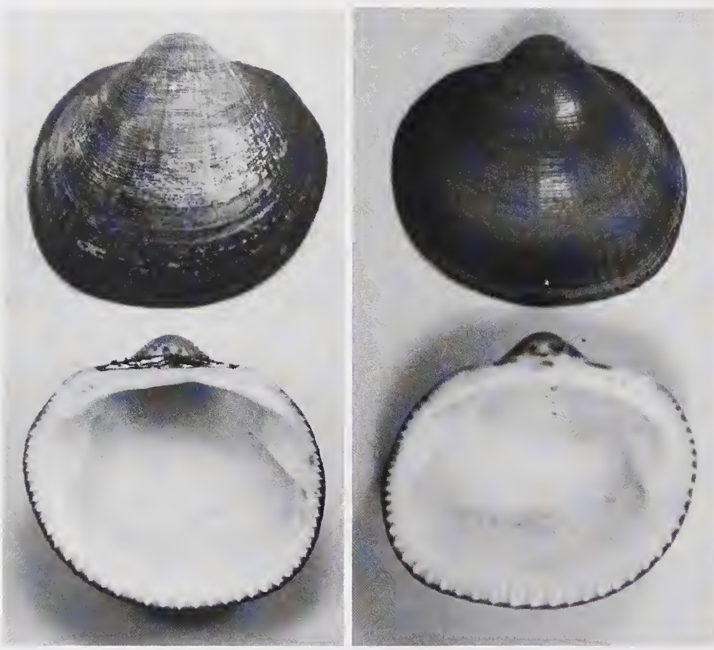

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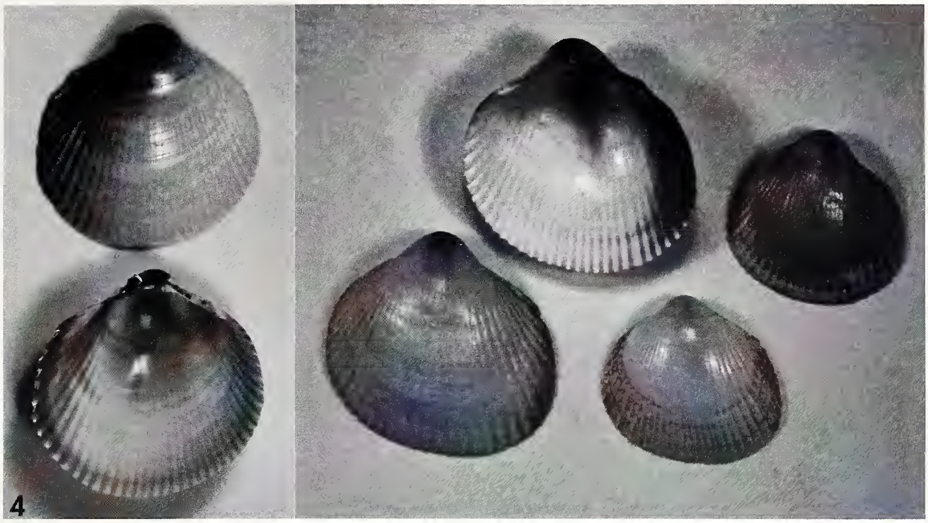
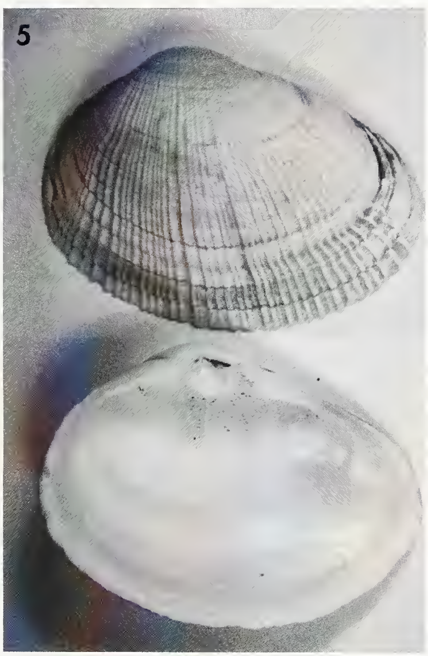
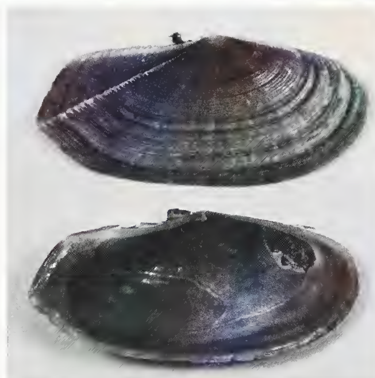
Figura 2. *Glycymeris violacescens* (Lamarck, 1819), ejemplares hallados en Mareny Blau (Sueca). Longitud de la mayor concha encontrada: 67 mm. Figura 3. *Glycymeris violacescens* (Lamarck, 1819), ejemplares hallados en Cullera. Longitud de la mayor concha encontrada: 64 mm.
Figure 2. Glycymeris violacescens *(Lamarck, 1819), specimens collected in Mareny Blau (Sueca). Length of the biggest shell found: 67 mm. Figure 3.* Glycymeris violacescens *(Lamarck, 1819), specimens collected in Cullera. Length of the biggest shell found : 64 mm.*







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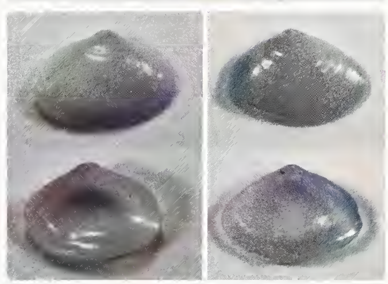

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Figura 4. *Fulvia fragilis* (Forsskal *in* Niehbur, 1775), ejemplares hallados en Cullera (izquierda) y Oliva (derecha). Longitud de la mayor concha encontrada: 42 mm. Figura 5. Conchas de *Eastonia rugosa* recolectadas en Meliana. Longitud de la mayor concha encontrada: 80 mm. Figura 6. *Gari fervensis*, ejemplar hallado en Cullera. Longitud de la mayor concha encontrada: 35 mm. Figura 7. Conchas de *Lentidium mediterraneum* recolectadas en Mareny Blau (Sueca). Longitud de la mayor concha encontrada por el autor de esta especie: 8 mm.

Figure 4. Fulvia fragilis *(Forsskal in Niehbur, 1775), specimens collected in Cullera (left) and Oliva (right). Length of the biggest shell found: 42 mm. Figure 5.* Eastonia rugosa *shells collected in Meliana. Length of the biggest shell found: 80 mm. Figure 6.* Gari fervensis, *specimen collected in Cullera. Length of the biggest shell found: 35 mm. Figura 7.* Lentidium mediterraneum *shells collected in Mareny Blau (Sueca). Length of the biggest shell found: 8 mm.*

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New data on the Caribbean Triphoridae (Caenogastropoda, Triphoroidea) with the description of 26 new species

Nuevos datos sobre los Triphoridae (Caenogastropoda, Triphoroidea) del Caribe, con la descripción de 26 nuevas especies

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ABSTRACT

In the present work 68 taxa of the family Triphoridae from the Caribbean and adjacent areas are studied. Comments are also provided on one invalid taxon and on another that has been erroneously reported from this area. Among these, 30 were previously known species and 26 are described as new (*Metaxia propinqua, M. propria, M. prompta, Isotriphora guanahacabibes, Eutriphora auffenbergi, Marshallora ostenta, Marshallora apexdiversus, Inella pseudolongissima, I. noduloides, I. apexbilirata, I. harryleei, I. undebermuda, I. pseudotorticula, I. differens, I. slapcinskyi, I. faberi, Sagenotriphora candidula, "T." inaudita, "T." pseudonovem, "T." yociusi, "T." guadaloupensis, "T." amicorum, "T." turtlebayensis, "T." grenadensis, "T." abacoensis* and *"T." portoricensis*). Twelve species remain unnamed or are tentatively identified, due to scarcity or inadequacy of available material, or doubtful specific assignment. New information is reported for *Monophorus olivaceus* (Dall, 1889) and *Sagenotriphora osclausum* (Rolán and Fernández-Garcés, 1995) already treated in previous works.

Lectotypes are designated and figured for the following species *Inella bigemma* (Watson, 1880), *Inella inflata* (Watson, 1880), *Inella longissima* (Dall, 1881), *Inella triserialis* (Dall, 1881), *Inella intermedia* (Dall, 1881), *Inella ibex* (Dall, 1881), *Inella torticula* (Dall, 1881), *Inella colon* (Dall, 1881), *Inella compsa* (Dall, 1927), *Inella enopla* (Dall, 1927), *Inella meteora* (Dall, 1927), *Inella pompona* (Dall, 1927), *Inella dinea* (Dall, 1927), *Inella sentoma* (Dall, 1927), *Inella gaesona* (Dall, 1927), *"Triphora" cylindrella* (Dall, 1927), *"Triphora" abrupta* (Dall, 1881), *"Triphora" caracca* Dall, 1927, *"Triphora" georgiana* Dall, 1927, *"Triphora" indigena* Dall, 1927, *"Triphora" lilacina* (Dall, 1889), *"Triphora" pyrrha* Henderson and Bartsch, 1914, *Triphora" atlantica* (E. A. Smith, 1890) and for the western Atlantic species *Triphora aspera* Jeffreys, 1885.

A list of the names employed for Caribbean species of Triphoridae is given, mentioning mistakes and synonymies.

RESUMEN

En el presente trabajo se estudian 68 taxones de la familia Triphoridae del Caribe y aguas próximas. También se aporta información sobre un taxon que carece de validez y otro erróneamente mencionado para el área. Entre ellos, 30 corresponden a especies previamente conocidas, 26 se describen como nuevas para la ciencia (*Metaxia propinqua, M. propria, M. prompta, Isotriphora guanahacabibes, Eutriphora auffenbergi, Marshallora ostenta, Marshallora apexdiversus, Inella pseudolongissima, I. noduloides, I. apexbilirata, I. harryleei, I.*

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undebermuda, I. pseudotorticula, I. differens, I. slapcinskyi, I. faberi, Sagenotriphora candidula, "T." inaudita, "T." pseudonovem, "T." yociusi, "T." guadaloupensis, "T." amicorum, "T." turtlebayensis, "T." grenadensis, "T." abacoensis y *"T." portoricensis*) y a 12 de ellas no se les asigna un nombre definitivo debido a la escasez del material, o al mal estado del mismo, y también a la existencia de dudas sobre su determinación. Además, se aporta nueva información sobre *Monophorus olivaceus* (Dall, 1889) y *Sagenotriphora osclausum* (Rolán y Fernández-Garcés, 1995), especies ya citadas en trabajos previos.

Se designan y figuran lectotipos de las siguientes especies: *Inella bigemma* (Watson, 1880), *Inella inflata* (Watson, 1880), *Inella longissima* (Dall, 1881), *Inella triserialis* (Dall, 1881), *Inella intermedia* (Dall, 1881), *Inella ibex* (Dall, 1881), *Inella torticula* (Dall, 1881), *Inella colon* (Dall, 1881), *Inella compsa* (Dall, 1927), *Inella enopla* (Dall, 1927), *Inella meteora* (Dall, 1927), *Inella pompona* (Dall, 1927), *Inella dinea* (Dall, 1927), *Inella sentoma* (Dall, 1927), *Inella gaesona* (Dall, 1927), *"Triphora" cylindrella* (Dall, 1927), *"Triphora" abrupta* (Dall, 1881), *"Triphora" caracca* Dall, 1927, *"Triphora" georgiana* Dall, 1927, *"Triphora" indigena* Dall, 1927, *"Triphora" lilacina* (Dall, 1889), *"Triphora" pyrrha* Henderson y Bartsch, 1914 y también de la especie atlántica *Triphora aspera* Jeffreys, 1885.

Al final se aporta una lista de los nombres empleados para las especies de Triphoridae del Caribe, señalando los errores habidos y las sinonímias.

KEY WORDS: Triphoridae, Caribbean, new species.
PALABRAS CLAVE: Triphoridae, Caribbean, new species.

INTRODUCTION

Triphoridae J. E. Gray, 1847 is a very diverse family of marine gastropods that occurs world-wide, with about 600 names proposed for the Recent species (Marshall, 1983). Triphorids live on rocky substrates from the intertidal fringe to a depth of more than 1000 m. A complete general information on the family Triphoridae is given by Marshall (1983) and Wells (1998), who noted that it is a highly species-rich group, most species being sinistral, with a high spire, numerous whorls, a short to long anterior canal and a posterior apertural notch or canal. The teleoconch sculpture of triphorids is notably variable, and can be beaded, spinose or reticulate, and the shells are small (usually less than 10 mm, although some can be up to 40 mm or more). Marshall (1983), in his revision of the Indo-Pacific species, emphasized the importance of the shape and sculpture of the protoconch for taxonomy, and pointed out that "under absolutely no circumstances should further new species be proposed unless a complete, unworn protoconch can be illustrated".

The family has its maximum diversity in the tropical Indo-Pacific where, according to Marshall (1983), there are more than 1000 species. An impression of the wealth of species in this area is afforded by the 174 species found during an extensive sampling in the coral reef lagoon of Koumac, New Caledonia (Bouchet *et al.*, 2002), Triphoridae being the second richest family of molluscs, after Turridae.

Although notably less diverse than in the Indo-Pacific, this family contains many species in the Atlantic Ocean, poorly known in most areas. Bouchet and Guillemot (1978) and Bouchet (1985, 1997) revised the species of this family occurring in the Mediterranean and neighbouring Atlantic, where CLEMAM data base recognised 19 species in 10 genera. Some additional species were described by Fernándes and Rolán (1988, 1993) and Van der Linden (1998) in the Cape Verde Islands,

and Rolán and Peñas (2001) from the Canary Is. and the Mediterranean.

Information on triphorids from many Caribbean areas is contained in a number of works, such as those for Jamaica (C. B. Adams, 1850a, 1850b, most species represented in Clench and Turner, 1950), Virgin Islands (Nowell-Usticke, 1959 and 1971), Yucatan Peninsula, Mexico (Vokes and Vokes, 1983), Puerto Rico and nearby Caribbean areas (Warmke and Abbott, 1961), Curaçao, Aruba and Bonaire (De Jong and Coomans, 1988), Oceanic Islands off Brazil (Leal, 1991), Colombian Caribbean (Díaz Merlano and Puyana Hegedus, 1994), the Atlantic and Gulf coasts and West Indies (Morris, 1973), and Brazil (Rios, 1994). Rolán and Fernández-Garcés (1993a, 1993b, 1994 and 1995) and Rolán and Espinosa (1994) showed the known species from Cuba and described some new species. Besides, other authors described new species from other Caribbean areas, such as De Jong and Coomans (1988), Moolenbeek and Faber (1989), Faber and Moolenbeek (1991), Rolán and Crúz-Ábrego (1996) and Rolán and Luque (1999). More recently a large new species has been described from Brazil (Simone, 2006). Many other species were recorded from deep water, and described by Watson (1880, 1886), Dall (1881, 1889, 1927) and other authors.

Fossil species were mentioned in Olsson and Harbison (1953).

Colour photographs of 33 species, including most of the known shallow-water species and those described during the last 20 years in previously mentioned papers, are provided in a recent paper (Rolán and Fernández-Garcés, 2007) together with a list of names assigned to the Caribbean Triphoridae.

Hence, the present work has the following objectives: 1- To give available information on the deeper water species, showing the type material whenever possible; 2- To provide additional colour photographs of the Caribbean species which were not figured in our previous work (Rolán and Fernández-Garcés, 2007); 3- To supply additional information that has recently been obtained on other species already known from shallow water; 4- To describe some new species which have been collected from shallow water; 5- To present an updated list of all the taxa mentioned for the Caribbean and nearby areas, making corrections to our previous list.

MATERIAL AND METHODS

Some of the species presented here are only known from the type material, loaned by several museums (mentioned in Abbreviations and Acknowledgements), or viewed on photographs, provided by their Curators or other personnel. In the collected material, the collector name and the data of collection were referred when both were known. Besides, material loaned by Harry G. Lee from his collection, mainly from deep water, is included in this study. Finally, a few species were collected by the authors and persons who have cooperated with them. Most of the early described species, some of which had never been figured previously or had only been represented by drawings, are photographed here in colour, and whenever possible these figures include the types and also illustrate intraspecific variability. Some photos taken by Sally Diana Kaicher (found in ANSP) were included.

The order of presentation is basically a grouping based on similarity. It was also the authors' intention to include most of the available information on protoconchs, radulae and opercula, but unfortunately this was only possible with a few species. Most of the type material excluded this possibility, and much of the studied material consisted of shells without soft parts. An attempt has been made also to solve taxonomic problems relevant to some of the studied taxa.

None of Dall's descriptions included a designated holotype, although some

seem to have been based on a single shell. Under these circumstances, Dall's material placed in some museums must be considered as syntypes. After examination of available material from these museums, it was therefore decided to designate as lectotypes the shells that were closest to the original description or the original figure (shown in DALL, 1889).

In the description of shells, the spiral beaded cords are frequently referred to as "spiral 1, 2, 3 etc.", spiral 1 being the subsutural cord on the adapical part of the whorl, with subsequent cords on the teleoconch whorls referred to as spirals 2 and 3, following MARSHALL (1983).

Other important characters in the description are, those of the protoconch, such as the diameter, the shape and size of the nucleus (elevated, depressed, large, small, ...), the number of spiral cords (none, 1 or 2), and the presence or absence of axial ribs. We have followed the method of VERDUIN (1976) for counting the number of whorls of the protoconch. On the teleoconch, the number and size of the spiral cords is noted on the first and last whorls, where they are frequently different. Also noteworthy is the position of spiral 2 (closer to spiral 1, equidistant between spirals 1 and 3) and its size (nodules smaller, elongate, etc.). It is important to point out that the nodules, which are formed by the intersection of spirals and axial ribs, are sometimes simply spherical, while other times they are concave above and convex below; in this case they are crossed by a line that represents the spiral cord and appears to cut the nodule: these are referred to as cut nodules or nodules that are cut in the middle.

Due to the fact that the radula of most species was unavailable, and as this character is very important for generic assignment, it was necessary in many cases to employ generic names very much in a *sensu lato* as "*Triphora*" or "*Inella*". For generic arrangement we mainly follow the works of LASERON (1958), MARSHALL (1983) and BOUCHET (1985).

Abbreviations:

AMNH: American Museum of Natural History, New York
ANSP: Academy of Natural Sciences, Philadelphia
BMSM: Bailey-Matthews Shell Museum, Sanibel Is., Florida
FLMNH: Florida Museum of Natural History, Gainesville, Florida
IES: Instituto de Ecología y Sistemática, La Habana
MCZ: Museum of Comparative Zoology, Cambridge
MHNS: Museo de Historia Natural, Santiago de Compostela
MNCN: Museo Nacional de Ciencias Naturales, Madrid
USNM: United States National Museum, Washington
CCR: collection of Colin Redfern
CHL: collection of Harry G. Lee
CFG: collection of Raúl Fernández-Garcés
CMK: collection of Marlo Krisberg
sp: specimen with soft parts
s: shell
j: juvenile
f: fragment

RESULTS

I. TAXONOMIC PART

Family TRIPHORIDAE Gray, 1847
Subfamily METAXIINAE Marshall, 1977
Genus *Metaxia* Monterosato, 1884

Type species: *Cerithium rugulosum* C. B. Adams, 1850. According to MARSHALL (1983), this subfamily is formed by dextral triphorids.

Metaxia propinqua spec. nov. Rolán and Fernández-Garcés (Figs. 1C-H)

Type material: Holotype (Figs. 1C, 1D) in FLMNH (154988). Paratypes: 4 s, Louisiana, 27.98568° N 92.6472° W, 65-91 m (FLMNH UF 291348); 5 s, Hillsborough Co., SW Egmont Key, Florida 73-91 m (collector Steger) (FLMNH 238632); 2 s (Figs. 1E, 1F), Palm Beach Co., Florida, off Boynton Inlet, 84-106 m (M. Glockstein, 1980) (FLMNH 47382).
Other material examined: 2 s (with broken protoconch), Louisiana, 27.98568° N, 92.6472° W, 65-91 m (FLMNH UF 291348); 4 s (protoconch lost or eroded), Hillsborough Co., SW Egmont Key, Florida 73-91 m (Steger) (FLMNH 238632); 1 s (protoconch eroded), 2 miles off Virginia Key, Florida, 9 m (FLMNH UF 365086); 1 s (protoconch eroded) (FLMNH).
Type locality: Florida, Monroe Co, WNW Dry Tortugas, 76 m.
Etymology: The specific name derives from the Latin word *propinquus -a -um* which means "close, similar", alluding to the similarity with other species of this genus.

Description: Shell conical, very elongate, relatively solid. Protoconch (Figs. 1G, 1H) white, paucispiral, with a little more than two whorls and about 300 µm in diameter; several spiral threads begin at the apex. These are well defined, a little irregular, four on the first whorl decreasing to two on the second, where numerous axial ribs run from the suture to the upper thread. The teleoconch can be white or light brown. Four spiral cords are present from the beginning, with the subsutural upper one less prominent than the other three. Axial ribs are present on the entire shell, about 10-11 on the first whorls and eighteen on the final one. Suture depressed with a very small spiral thread above. On the base, the profile is slightly concave and one additional cord is present. Aperture almost round with an open and short siphonal canal.

Dimensions: The holotype measures 6.3 mm.

Distribution: Known from Florida and Louisiana, USA.

Remarks: In order to facilitate comparison of the protoconchs of the *Metaxia* species mentioned here, they have all been presented together in Figure 3.

M. rugulosa has a protoconch (Figs. 3A-3D) with 2 $^{1}/_{2}$ whorls (see ROLÁN AND REDFERN, 1996), sometimes reaching three whorls, with a spiral sculpture on the first whorl formed by undulating or zigzagging lines; the second protoconch whorl has axial ribs which terminate at a single spiral thread (only exceptionally double); the teleoconch is white. *M. excelsa* and *M. taeniolata* have multispiral protoconchs.

Metaxia propria spec. nov. Rolán and Fernández-Garcés (Figs. 2A-C)

Type material: Holotype (Figs. 2A, 2B) in FLMNH (UF 393603).
Type locality: Florida, Key Largo, 228 m.
Etymology: The specific name derives from the Latin word *proprius -a -um* which means "special, characteristic", alluding to the differential characters of the protoconch that distinguish it from other species of this genus.

Description: Shell conical, very elongate, relatively solid. Protoconch white (Fig. 2C) with a little more than 2 $^{3}/_{4}$ whorls and about 400 µm in diameter; two well defined spiral cords are crossed by 13-15 axial ribs per whorl which are continuous with those of the subsequent whorl. Teleoconch white. Four spiral cords are present from the beginning, the subsutural upper one being less prominent than the other three. Axial ribs present on the entire shell, with about 10-11 on the first whorls and 13 on the final one. Suture depressed with a very small spiral thread above. On the base, the profile is slightly concave and one additional cord is present. Aperture almost round, with an open siphonal canal.

Dimensions: The holotype measures 5.9 mm.

Distribution: Only known from Florida.

Remarks: Characters of the protoconch provide the main differences between this species and those previously known:

M. rugulosa has a protoconch (Figs. 3A-3D) with 2 1/2 whorls, sometimes reaching 3, with a spiral sculpture on the first whorl formed by undulating or zigzagging lines; the second protoconch whorl has axial ribs which terminate at a single spiral thread (only exceptionally double).

M. propinqua spec. nov. lacks axial ribs on the first whorl, and they reach only to the upper spiral cord on the second whorl.

Metaxia prompta spec. nov. Rolán and Fernández-Garcés (Figs. 2D-J)

Type material: Holotype (Figs. 2D, 2E) and 2 paratypes (Figs. 2G, 2I) (FLMNH UF 359136).
Type locality: Bermuda, Hamilton Parish, Shelly Bay.
Etymology: The specific name derives from the Latin word *promptus –a -um* which means "evident, available", alluding to the characters of the protoconch that are different from other species of this genus.

Description: Shell conical, very elongate, relatively solid. Protoconch (Figs. 2F, 2H, 2J) white, paucispiral with about 2 1/2 whorls and between 300 and 400 µm in diameter; a single spiral cord is poorly defined on the first whorl and a little stronger on the second. The axial ribs are numerous but not continuous; they descend from the upper suture and almost disappear just before reaching the spiral cord, reappearing and strengthening on the cord before fading again towards the lower suture. Teleoconch white or light brown. Four spiral cords are present from the beginning, the subsutural upper one being less prominent than the other three. Axial ribs are present on the entire shell, varying in number on the early whorls and increasing to about 18 on the final one. Suture depressed with a very small spiral thread above. On the base, the profile is slightly concave. Aperture almost round with an open siphonal canal.

Dimensions: The holotype measures 4.1 mm.

Distribution: Only known from Bermuda Archipelago.

Remarks: Characters of the protoconch easily differentiate this species from related ones:

M. rugulosa has more rounded whorls with zigzagging spiral lines on the first whorl and numerous axial ribs on the second, which only reach the middle of the whorl.

M. espinosai has more angulate, wider whorls, with prominent elongate nodules and is always milky white.

M. propinqua has rounded whorls, with straight spiral cords beginning at the apex and two cords on the second whorl, with axial ribs absent from the lower half of the whorl.

M. propria has almost three whorls, rounded with two spiral cords and with a few widely separated and prominent axial ribs on the first whorls.

Metaxia sp. 1 (Figs. 1A-B)

Material examined: 1 s, Barbados, 183 m (USNM, labeled "*Cerithiopsis abrupta* Watson, 1880").

Remarks: The shell from Barbados in USNM (without any type label) has a paucispiral protoconch of 450 µm in diameter, differing from *M. abrupta* (Watson, 1880), which has a protoconch that is more depressed and also has axial ribs (figured in BOUCHET, 1985).

Dimensions: The shell studied measures 5.0 mm.

Bouchet (1985) was unable to confirm the existence of *M. abrupta* in the western Atlantic. Probably this species is endemic to the Azores Archipelago. The species studied here could be the one referred to by Dall (1889) as *Cerithiopsis abruptus* (Fig. 36L), but we are not sure.

This species is different from the other two Caribbean species with paucispiral protoconch: *M. espinosai* (described by Rolán and Fernández-Garcés, 1993a) has a paucispiral protoconch (Fig. 3E) with a prominent nodulous keeled border; and *M. rugulosa* (C. B. Adams, 1850), which has a narrower protoconch (Figs. 3A-3D) with a different sculpture (Rolán and Redfern, 1996). However, it must be pointed out here that the protoconch of the taxon *M. rugulosa* is not known, as the apex is missing from the holotype of this species, represented in Clench and Turner (1950). Another fragment in BMNH with the label "figured specimen" had no protoconch.

In several works it has been assumed that the protoconchs from Cuba and the Bahamas figured in Rolán and Redfern (1996) represent the protoconchs of *M. rugulosa*, probably due to the proximity of Cuba to Jamaica, which is the type locality. Similar protoconchs were figured in Redfern (2001).

The other two known species of Caribbean *Metaxia* (*M. excelsa* and *M. taeniolata*) have multispiral protoconchs.

The present species is probably unknown and unnamed, but as only one shell has been examined, and its protoconch is not in very good condition, it is kept unnamed pending the availability of more material in the future.

Subfamily Triphorinae Gray, 1847
Genus *Monophorus* Granata-Grillo, 1877

Type species (by monotypy): *Trochus perversus* Linnaeus, 1758. Recent, Mediterranean.

Remarks: The main characters (shown in Marshall, 1983, Bouchet, 1985 and Rolán and Fernández-Garcés, 1994) are the following: multispiral protoconch, teleoconch whorls flat-sided or shallowly convex, well defined spiral cords and axial ribs, nodular intersections and a typical radula with central tooth with 3-5 cusps, lateral with 5-6 and numerous marginals with only 2-3 short cusps.

Monophorus olivaceus (Dall, 1889) (Figs. 4B-F, 4H-K)

Triforis decorata var. *olivacea* Dall, 1889. *Bull. M. C. Z.*, 18: 243. [Type locality: Gulf of Mexico, west of Florida, 91 m, Key West, Hemphill].
Triphora ornata auct. non Deshayes (1832).

Type material: One syntype, fragment of 10 mm, here designated as lectotype (Figs. 4C, 4D) (MCZ 7379).
Other material examined: Mexico: 1 s, Cancun, Quintana Roo (Heilman, March, 1963) (ANSP 285517). Florida: 3 s, WSW of John's Pass, 50 m (Steger, 1956) (ANSP 306254); 1 s, Palm Beach Co., Bath and Tennis (McGinty coll/Apr. 1951), 36-55 m (FLMNH 176649); 4 s, Collier Co., SW of Naples, 26 20′ N (Powlus/Aug., 1960), 55 m (FLMNH 158202); 9 s, Palm Beach Co., off Palm Beach, 100 m (FLMNH 154886); 3 s, Palm Beach, WOE Radio Towers to Bath and Tennis (McGinty, May/1951) 36-55 m (FLMNH 250132); 1 s, Palm Beach Co., (R/V Triton, Apr. 1950) 40-50 m (FLMNH 204877); 1 s, off Marathon (M. and S. Snyder, Jul. 1966) (ANSP 309744). Bahamas: 1 s, reef NE of North Point, Elbow (Little Guana) Cay, Abaco (Robertson, Aug. 1955) (ANSP 298409); 4 s, Grand Bahama Island, 26° 31′ 00″ N, 78° 46′ 30″ W (J.N. Worsfold) (ANSP 373939); 1 s, Grand Bahama Island, 26° 29′ 45″ N, 78° 37′ 15″ W (G. Taylor and D. Nilsen) (ANSP 273605); 2 s, Tamarind, Grand Bahama Island 26° 30′ 45″ N, 78° 36′ 00″ W (J. Worsfold) (ANSP 368896); 1 s, Bootle Bay, Grand Bahama Island 26°

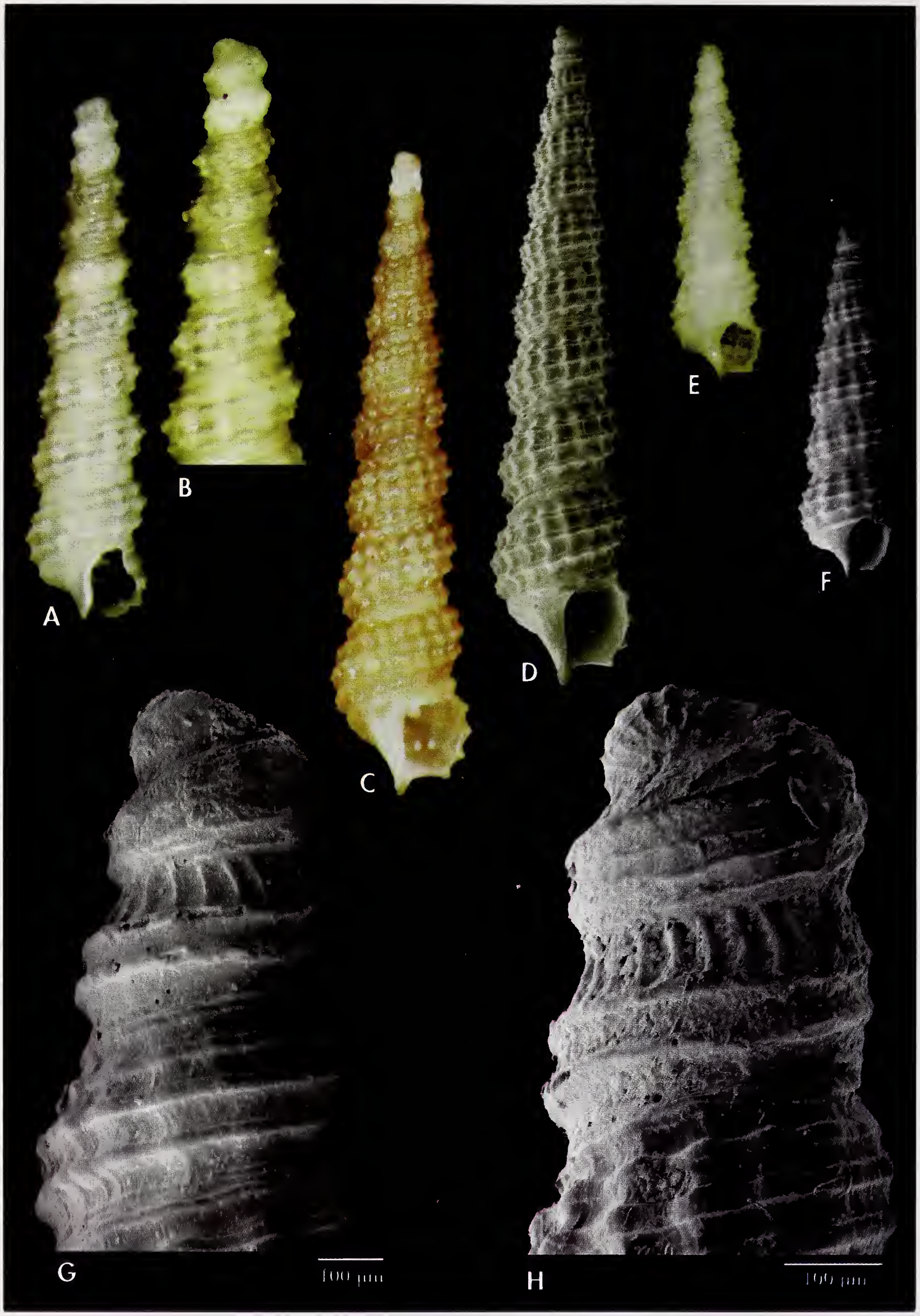

Figure 1. A, B. *Metaxia* sp. 1. A: shell, 5 mm, Barbados, 183 m (USNM); B: protoconch. C-H. *Metaxia propinqua* spec. nov. C, D: holotype, 6.3 mm (FLMNH); E, F: paratype, 3.4 mm (FLMNH); G: protoconch of the paratype; H: detail of the protoconch of the holotype.

Figura 1. A, B. Metaxia *sp. 1. A: concha, 5 mm, Barbados, 183 m (USNM); B: protoconcha. C-H.* Metaxia propinqua *spec. nov. C, D: holotipo, 6,3 mm (FLMNH); E, F: paratipo, 3,4 mm (FLMNH); G: protoconcha del paratipo; H: detalle de la protoconcha del holotipo.*

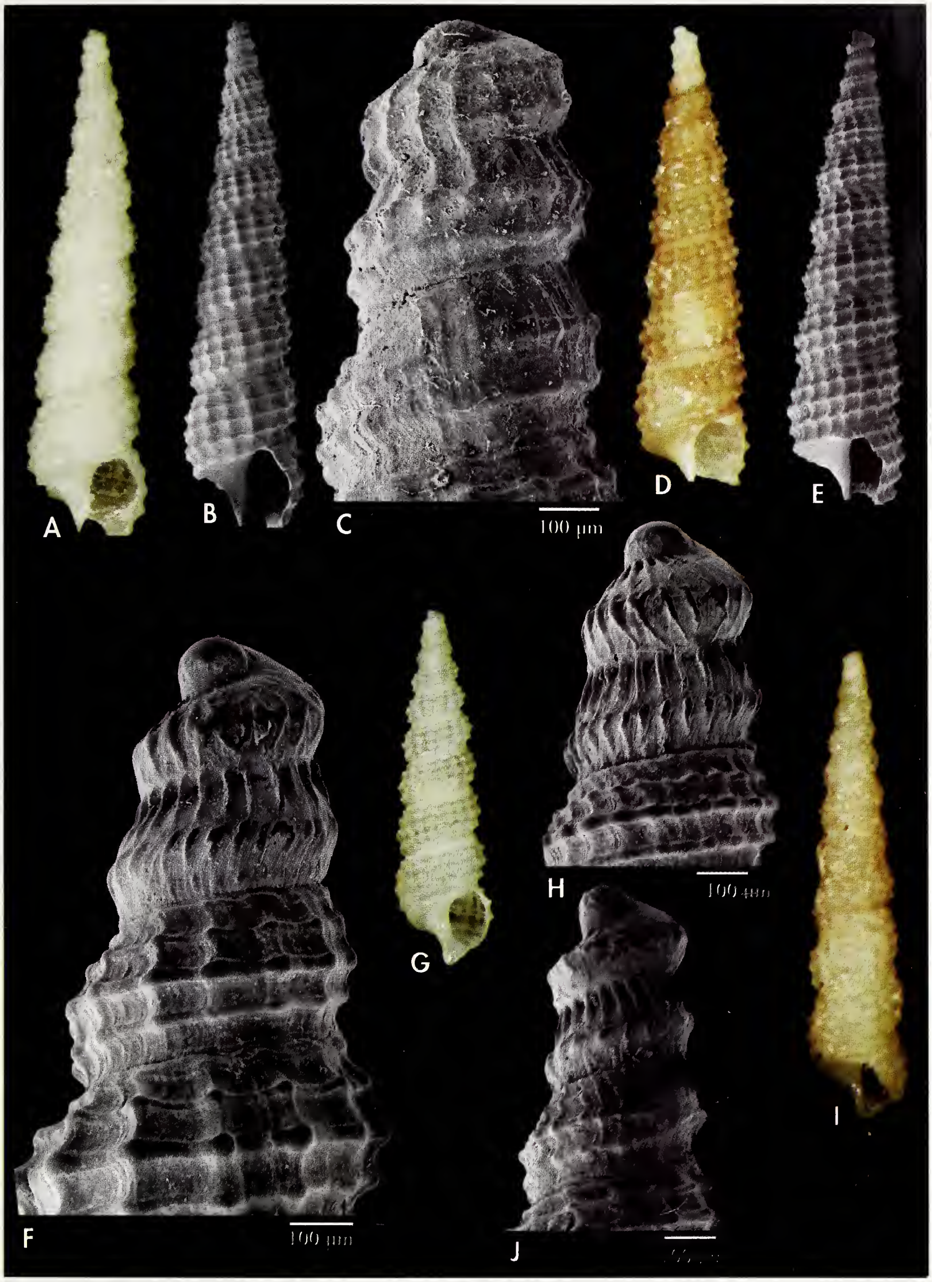

Figure 2. A-C. *Metaxia propria* spec. nov. A, B: holotype, 5.9 mm (FLMNH); C: protoconch of the holotype. D-J. *Metaxia prompta* spec. nov. D, E: holotype, 4.1 mm (FLMNH); F, G: protoconch and shell of paratype, 3.3 mm (FLMNH); H, I: protoconch and shell of paratype, 4.0 mm (FLMNH); J: protoconch of holotype.

Figura 2. A-C. Metaxia propria *spec. nov. A, B: holotipo, 5,9 mm (FLMNH); C: protoconcha del holotipo. D-J.* Metaxia prompta *spec. nov. D, E: holotipo, 4,1 mm (FLMNH); F, G: protoconcha y concha de un paratipo, 3,3 mm (FLMNH); H, I: protoconcha y concha de un paratipo, 4,0 mm (FLMNH); J: protoconcha del holotipo.*

39′ 30″ N, 78° 57′ 00″ W (J. Worsfold) 80 m (ANSP 371846); 1 s, Schooner Cays, NW of Powell Point, Eleuthera 24° 56′ 45″ N 76° 25′ 00″ (R. Robertson) (ANSP 363405); 3 s (G. Buchanan) (BMNH 90.11.24.428-34). Venezuela: 4 s, distrito Federal (Berthier, 1935) (ANSP 264204). Grenada: 1 s, mouth of St. George Harbour (Ostheimer, Jan. 1964) 44-66 m (ANSP 297306). Virgin Islands: 3 s, St. Croix (R.E. Griffith) (ANSP 18201). Dutch Antilles: 5 s, (Gray coll.) Saint Vincent (BMNH). No exact locality: 3 s (McAndrew coll.) (BMNH Acc n° 1563); 2 s (R. Sykes coll.) (BMNH acc. n° 1825).

Description: See DALL (1889). It is important to point out some characters: the large size of the beads, spiral 2 being absent from the early whorls and smaller on most of the shell, the colour forming blotches, predominantly on spirals 1 and 2. Spiral 3 is white, but the cord between the beads is usually dark.

Dimensions: The lectotype measures 10 mm.

Distribution: Known throughout the Caribbean.

Remarks: There is considerable confusion regarding this taxon: the species was referred to as *Triphora ornata* by many authors (WARMKE AND ABBOTT, 1961; MORRIS, 1973; RIOS, 1994) until MOOLENBEEK AND FABER (1991) showed the correct name to be *M. olivaceus* (Dall, 1889). The type material of *Triphora ornata* was examined by Faber (pers. comm.) in 1983 from MNHN (Ecole des Mines collection where the Deshayes types should have been). This lot consists of several poor shells, none of which matches the Caribbean species, and one of them in better condition corresponds to a Red Sea species.

The only known type specimen of *Triforis decorata* var. *olivacea* is an atypical and faded shell. It can be confused with some species with axial colour blotches: *Latitriphora albida* (Fig. 4A) has very characteristic smaller nodules, and no confusion is possible; *Nototriphora decorata* may be more similar and requires careful comparison. We have compared a typical shell of *Nototriphora decorata* (Fig. 4G) with representative shells of *M. olivaceus* (Figs. 4D-F) and with the lectotype of the latter species (Figs. 4B, C). It can be seen that the early whorls of *N. decorata* are narrower than those of the type of *M.olivaceus* and have smaller nodules, whereas the early whorls of representative *M. olivaceus* are very similar to those of the type specimen. As it is necessary for nomenclatural stability to designate a lectotype, we propose as such the only known syntype.

The species *M. olivaceus* is very variable, with large, wide shells sometimes found in the same population as small, narrow ones. Also, the dark colour may vary from almost black to light brown and can be variably distributed, but it is always present on spiral 1 and on a few nodules of spiral 2.

Examination of a shell from Florida (Figs. 4H-4J) revealed a dark subsutural spiral and a dark base. It appeared slightly different from average examples of *M. olivaceus* (like Fig. 4K), as the colour is not only darker but is also slightly differently distributed; spiral 1 has only isolated white beads and the brown color does not form blotches, spiral 2 is mostly white and spiral 3 is totally white, without any brown colour between the beads. Also the beads on spiral 2 become comparatively larger several whorls before the final whorl. However, it is considered to be only a variety.

Genus *Isotriphora* Cotton and Godfrey, 1931

Type species (by original description) *Triforis tasmanica* T. Wood, 1875. Recent, South Australia, Tasmania.

Description: The most important character of this genus is the paucispiral protoconch with nodular spiral cords, close to that of the genus *Eutriphora* Cotton and Godfrey, 1931, but the latter has axial riblets. Operculum multispiral.

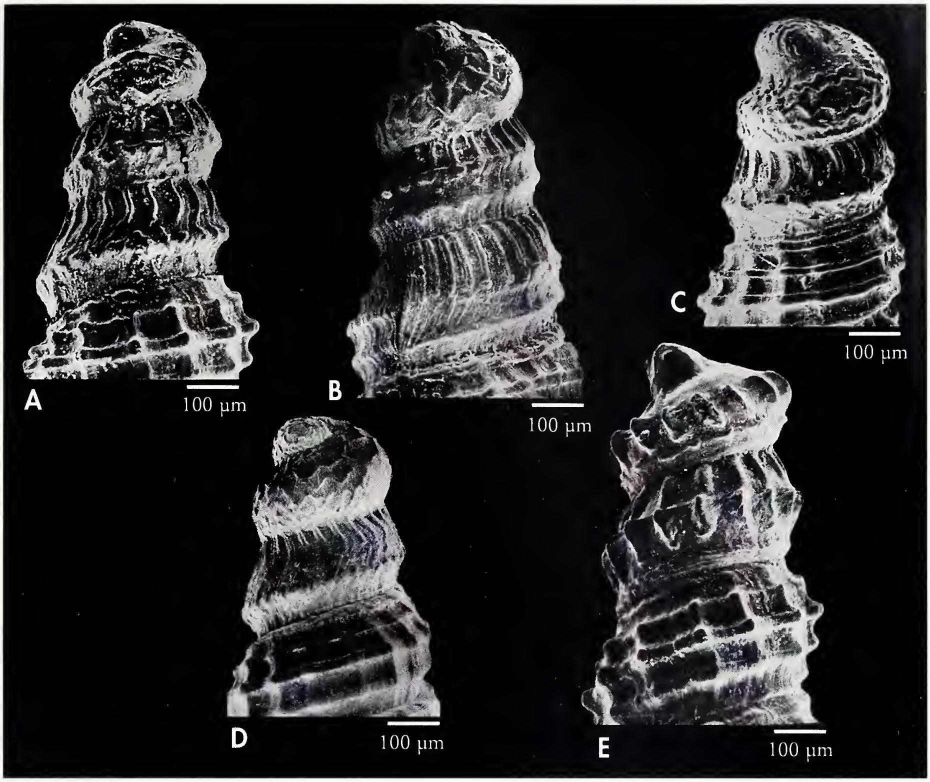

Figure 3. Protoconchs of *Metaxia* species. A-D. *M. rugulosa* (C. B. Adams, 1850) from Cuba (A) and Bahamas (B-D). E. *M. espinosai* Rolán and Fernández-Garcés, 1993, Cuba.
Figura 3. Protoconchas de especies de Metaxia. *A-D.* M. rugulosa *(C. B. Adams, 1850) de Cuba (A) y Bahamas (B-D). E.* M. espinosai *Rolán y Fernández-Garcés, 1993, Cuba.*

Isotriphora guanahacabibes spec. nov. Rolán and Fernández-Garcés (Figs. 5A-H)

Type material: Holotype (Fig. 5A) in MNCN (15.05/15.05/47054) and paratypes in the following collections: MHNS, 2 s (Fig. 5B); IES, 1 s (Fig. 5C); CFG (3 s, 8 f), all from the type locality; 1 f and 1 j, from Cienfuegos, Cuba (MHNS); 1 s, outer slope of beach, W of Georgetown, Cayman Is. 100-115 fms (Tyler, Oct. 1964) (ANSP 300623).
Other material examined: 2 f, Cienfuegos Bay, Cuba 40 m; 1 j, S shore of island, 3 miles E of Southwest Point, Cayman Brac Island (ANSP 397055).
Type locality: From sediment at Cueva de Pipo, Maria la Gorda, Guanahacabibes, Pinar del Río, Cuba, at 35 m.
Etymology: The specific name comes from the type locality.

Description: Shell (Figs. 5A-5C) whitish, conical elongate, solid. Protoconch (Figs. 5D-5F) paucispiral with about 300 µm in diameter, the number of whorls not appreciable due to indeterminate separation from the teleoconch.

The protoconch begins with a very narrow nucleus and the following two whorls have two prominent nodular spirals, with another very small one below the suture. Teleoconch with about 10 whorls and with a straight profile; each

whorl with two widely separated nodulous spiral cords (spirals 1 and 3), the lower one more prominent; about the 6-7th whorls, a small cord (spiral 2) appears closer to spiral 1 (Fig. 5G). Spiral 2 continues onto the subsequent whorls, becoming narrow, undulating and slightly nodulous towards the end. Spiral 2 is always smaller than spiral 1 and 3 and is closer to the one above. On the last two whorls an additional very small, smooth spiral 4 appears at the suture. The aperture is ovoid, the outer lip fine and prominent. Near the end of the final whorl there is a small hole, located close to the apertural border on the upper part of the whorl.

Siphonal canal closed, curving towards the rear. The colour is totally white, but some specimens can have small areas of light brown (Fig. 5C). Under high magnification spiral striae (Fig. 5H) can be seen between the spirals.

Dimensions: The holotype measures 5.5 x 1.6 mm.

Distribution: Known from the type locality and from the Cayman Islands, down to 183-210 m.

Remarks: This species must be compared with the other congeneric species with a similar protoconch:

Isotriphora peetersae (Moolenbeek and Faber, 1989) is dark brown, except for the protoconch and first whorls of the teleoconch, and the shell is more obese and with fewer whorls. Furthermore, the anal sinus is at the end of the spire and is not closed.

Isotriphora taenialba Rolán and Espinosa, 1994, is similar to *I. peetersae* but a little larger, and always has dark and lighter bands of colour; also the anal sinus is open at the end of the spire.

At first sight it might be confused with species of the genus *Iniforis* Jousseaume, 1884 such as *I. immaculata*, which is totally white, but that species has a protoconch with only one smooth fine cord.

Genus *Eutriphora* Cotton and Godfrey, 1931

Type species (o. d.): *Triphora cana* Verco, 1909, Recent, Australia.

Description: After MARSHALL (1983), similar to the genus *Isotriphora* but with multispiral protoconch with axial riblets. Radula with the rachidian tooth having three cusps, lateral teeth with 4-5 and numerous marginal teeth with an elongate central cusp. Operculum paucispiral.

Eutriphora auffenbergi spec. nov. Rolán and Lee (Figs. 6A-I)

Type material: Holotype (Figs. 6A-6B) in FLMNH. Paratypes: 1 s (Fig. 6C) (BMSM); 1 s (USNM); 1 s (CHL), all from type locality and *ex* CHL. Other paratypes: 3 s, 1 j, off Egmont Key, Hillsborough Co., Florida, 76 m (Jim Moore/*Cavalier*, 1962) (CHL); 1 j, 65 miles E St. Augustine, St. Johns Co., Florida (T. Yocius, Jun. 1972), 54 m (CHL); 1 j, 32 miles E St. Augustine, St. Johns Co., Florida (T. Yocius, Jun. 1981), 30 m (CHL); 4 s (Fig. 6D), Florida, (MCZ 356088); 1 s (Fig. 6E), Florida, 5 m (MCZ 356096); 1 s, Hillsborough Co., W of Egmont Key, Florida, 274 m (FLMNH 169703); 1 sp, Palm Beach Co., E of Palm Beach, Florida, 183-578 m (FLMNH 257207).
Other material examined (in bad condition): 1 s, 10 f, Pinellas Co., WSW John's Pass, Florida, (D. Steger) 68 m (FLMNH 238662).
Type locality: West of Dry Tortugas, Monroe Co., Florida, USA (Jim Moore/*Cavalier*, 1972), 90 m.
Etymology: The species is named after Kurt Auffenberg, former Collections Manager in Malacology, Florida Museum of Natural History, USA.

Description: Shell (Figs. 6A-6E) sharp-pointed, elongate, solid, brown or light brown. Protoconch (Fig. 6G) multispiral, with about 4 whorls, the surface of the apex with small tubercles and the subsequent whorls with two small

spiral cords crossed by numerous fine axial ribs that have a slight S-shaped curve. Teleoconch with about 17-18 whorls in large specimens, beginning with spirals 1 and 3, crossed by prosocline axial ribs which form small nodules at the intersection points. On whorls 4-5, spiral 2 appears close to spiral 1; on the subsequent whorls, the three spirals are similar in size but spiral 3 is a little more prominent. An additional spiral cord, appearing on about whorls 10-12, is slightly nodulous, always smaller, and is located just below the suture (Fig. 6F). This cord is more evident on the final whorl, where it occurs near the periphery. Below it there are two more smooth spiral cords, the lower one on the base of the siphonal canal (Fig. 6C). Aperture rounded, columella curved, siphonal canal elongate and recurved, closed at its base by an extension of the aperture.

Dimensions: The holotype measures 21.8 mm, with 20 whorls. Other shells are smaller.

Operculum (Fig. 6H): paucispiral, subcircular, yellowish, rather transparent, with the nucleus subcentral.

Radula (Fig. 6I): relatively large, with a formula 16-1-1-1-16, the rachidian tooth having three prominent cusps; the lateral has 5 cusps of which cusps 2 and 4 are smaller. The marginal teeth have a filiform central elongate cusp, with the other two short and similar in size.

Distribution: The species has been found only in Florida.

Remarks: The generic assignment is based on the similarity of the radula, operculum and protoconch to the type species of the genus *Eutriphora*: *E. armillata* (Verco, 1909) from Australia (see MARSHALL, 1983).

The holotype of *E. auffenbergi* spec. nov. resembles the figure of *T. triserialis* in DALL (1889: pl. 20, fig. 6a) (Fig. 36E), but the following characters of the present species are not coincident: the shell is brown and the protoconch also is darker, typically with 4 whorls and with tubercles on the apex; the siphonal canal is elongate. All these characters are dissimilar from Dall's species (see below).

Comparison and differentiation must be made with the following Caribbean species described here:

"Triphora" abrupta has a shorter shell, with the nodules less spherical, spiral 1 is very small and close to the suture, almost similar to spiral 4, while in *T. auffenbergi* spiral 1 is similar to the other main two.

"T." georgiana has a very small spiral 1 which remains reduced on the final whorls, and the protoconch probably has fewer whorls.

"T." caracca has two main spirals and between them a very narrow spiral 2; the axial ribs are very prosocline.

"T." indigena has a more convex profile to the whorls; the spiral cords are wider and the nodules at the intersection points are very small, resulting in rectangular pits in the interspaces between cords and ribs.

E. auffenbergi is somewhat similar to *Sagenotriphora osclausum* (Rolán and Fernández-Garcés, 1995) (see below), but the latter species is shorter (usually with no more than 9 teleoconch whorls), and the siphonal canal is also very short and curved.

Other brown species are *Marshallora nigrocincta* (C. B. Adams, 1839) and *M. modesta* (C. B. Adams, 1850), but these species have a shorter spire (not more than 10 whorls), a more convex profile and a very short siphonal canal.

Genus *Marshallora* Bouchet, 1985

Type species: *Murex adversus* Montagu, 1803 (o.d.).

Diagnosis: After BOUCHET (1985), protoconch of 4-5 whorls with two spiral threads, granules on its apical part, teleoconch with the second cord appearing later, operculum paucispiral and radula with central and lateral teeth

with two groups of cusps. Caribbean species in Rolán and Fernández-Garcés (1995) and Rolán and Crúz-Ábrego (1996).

Marshallora ostenta spec. nov. Rolán and Fernández-Garcés (Figs. 7A-N, 8E, 8F)

Type material: Holotype (Figs. 7A, 7B) in MNCN (15.05/47055) and a paratype (Fig. 7C) in IES, both from type locality. Other paratypes in the following institutions: 1 s (Fig. 7E), off Mayport, Duval Co., Florida (Yergin, Jan. 99), 30 m (FLMNH, *ex* CHL); 2 s (Figs. 7F, 7G), off Big Pine Key, Monroe Co., Florida, 30-50 m, (K. Sunderland, Aug/91) (BMSC *ex* CHL); 1 s, off Big Pine Key, Monroe Co., Florida, 30-50 m (K. Sunderland, 1991) (CHL, Fig. 7I); 3 s, off Egmont Key, Hillsborough Co., Florida (J. Moore/*Cavalier*, 1962), 72 m (CHL); 1 s (Fig. 7H), 32 miles E. St. Augustine, St. Johns Co., Florida (T. Yocius, 1972) 30 m (USNM *ex* CHL); 8 s, Palm Beach Co., Florida, off Boynton Inlet (D. and H. Akers, Dec. 1969) 33 m (FLMNH 177040); 1 s (Fig. 7J) Miami, Florida, 73 m (FLMNH UF363887); 1 s (Fig. 7K), Palm Beach Co., Florida, off Dodge Estate (R/V Triton, Dec. 1951) (McGinty coll.) (FLMNH 178201).
Other material examined: Cuba: 2 sp (Fig. 7D)(destroyed for radular study), Cienfuegos (MHNS). USA: Florida: 1 sp (destroyed for radular study) and 2 s, Anclote Key, near Tarpon Springs, Pasco Co. (CHL); 1 s, off Dry Tortugas, Monroe Co., Riley Black (*ex* J. Dawley, 1/4/1983), 55 m (CHL) (the last two lots not in good condition); 4 s, off Destin, 25 m (ANSP 252157); 1 s, Palm Beach Co., off Yamato Rocks, (F. B. Lyman/ Apr. 1939) 11 m (FLMNH 10242); 3 s, St. Augustine (FLMNH 286017).
Type locality: Cienfuegos Bay, Cuba.
Etymology: The specific name derives from the Latin past participle *ostentus –a, -um* which means "shown", indicating that the review of material from several collections allowed us to recognize this species.

Description: Shell (Figs. 7A-7K) light, solid, conical elongate. Protoconch (Figs. 8E, 8F) dark brown, multispiral, with between 3 $^1/_2$ and 4 whorls; the apex is covered by small tubercles; fine axial ribs are crossed by two spiral cords on the lower whorls and sometimes by a single cord on the first whorl. Teleoconch with 7-10 whorls, the first 4-5 with only two beaded cords (spirals 1 and 3); spiral 2 appears between them on about the fifth or sixth whorl, increasing in size until the three spirals are the same size on the final whorl. Another very small, smooth spiral occurs at the suture. The colour is usually white at the beginning of the teleoconch, sometimes including the first 1-2 whorls; subsequently the colour of the shell is more variable: frequently uniform cream or light brown, darker at the suture; the beaded cords may be different, whitish, cream or light brown, and either the lower or upper cord can be lighter. Aperture rounded; base brown, sometimes only light brown, the darker colour extending to the columella; siphonal canal short and open.

Dimensions: The holotype measures 4.2 mm; some paratypes reach 5.5 mm.

The soft parts (examined in only two specimens) are whitish, slightly translucent, with milk-white spots on the head and a few on the tentacles.

Operculum (Fig. 7N) rounded-ovoid, multispiral, with the nucleus somewhat deviated from the centre.

Radula (Figs. 7L, 7M) studied in one specimen from Cuba and another from Florida, has a formula n-1-1-1-n. The rachidian tooth has two parts with 5-6 sharp cusps at each side; the lateral ones are very similar to the central one; the marginal ones are sharp pointed, very elongate and narrow.

Distribution: Known from Cuba and Florida.

Remarks: In spite of the amount of material examined, it was not possible to arrive at a description that represented all the shells, suggesting that this must be a variable species. There are some differences in the protoconch (number of whorls, one or two spiral threads on the first whorl), but the main differences concern the very variable colour distrib-

Figure 4. A. *Latitriphora albida* (A. Adams, 1854) (BMNH). B, C. *Monophorus olivaceus* (Dall, 1889), lectotype, 10 mm (USNM). D-F. *M. olivaceus* typical shells from Cuba, all for comparison with the shell of the lectotype. G. *Nototriphora decorata* (C. B. Adams, 1850), Cuba. H-K. *Monophorus olivaceus* (Dall, 1889). H-J: shell, 7.0 mm, Peanut Island, Florida (MHNS); K: shell, 8 mm, Florida (FLMNH).

Figura 4. A. Latitriphora albida *(A. Adams, 1854) (BMNH). B, C.* Monophorus olivaceus *(Dall, 1889), lectotipo, 10 mm (USNM); D-F.* M. olivaceus, *conchas típicas de Cuba, todas para comparación con la concha del lectotipo. G.* Nototriphora decorata *(C. B. Adams, 1850), Cuba. H-K.* Monophorus olivaceus *(Dall, 1889). H-J: concha, 7,0 mm, Peanut Island, Florida (MHNS); K: concha, 8 mm, Florida (FLMNH).*

ution on the teleoconch and the initial appearance of spiral 2 between the 5th and 7th teleoconch whorls. All of this suggested to us that more than one species might be involved in the studied material. Anyway, some shells with clear differences have been separated from the initial lot, and these are described below (the following species). The remainder were considered to represent a single variable species, which future study of live collected material may confirm through observation of the colour of the soft parts and examination of radulae.

Similiphora intermedia (C. B. Adams, 1850) always has the spiral cords white and brown, with a rather uniform color pattern of a darker upper cord and a dark or light brown middle one; the soft parts are black. The radula has numerous teeth all similar in size.

Marshallora modesta (C. B. Adams, 1850) and *M. nigrocincta* (C. B. Adams, 1839) have similar shells but they are darker brown and never whitish. The protoconchs are somewhat different, being wider and shorter (as can be seen in Figures 8H and 8I).

Marshallora apexdiversus spec. nov. Rolán and Lee (Figs. 8A-D, 8G)

Type material: Holotype (Fig. 8A) and 3 s (Figs. 8B, 8C), paratypes (FLMNH UF363887) from type locality; 1 s, 1 s (Fig. 8D), Palm Beach Co., Florida, off Dodge Estate (R/V Triton, Dec. 1951) (McGinty coll.) (FLMNH 178201).
Type locality: Miami, Florida, 73 m.
Etymology: The specific name derives from the Latin words *diversus*, which means "different", and *apex*, referring to an important character for separation from other close species.

Description: Shell (Figs. 8A-8D) light, solid, conical elongate. Protoconch (Fig. 8G) light brown, with 5 whorls; the apex is covered by small tubercles and is very narrow; the whorls with fine axial ribs that are crossed by two spiral cords, the upper cord almost in the middle of the whorl and the lower one closer to the suture below. Teleoconch with 8-11 whorls, the first 2-3 with only two beaded cords (spirals 1 and 3); spiral 2 appears between them on about the fourth whorl, increasing in size until the three cords are of equal size on about the fifth or sixth whorls. Another very small, smooth spiral occurs at the suture on the final whorls. The colour is usually white on the first 2 whorls of the teleoconch; on subsequent whorls spiral 1 is light brown, and on some shells (but not on the holotype)this colour also reaches the suture. The nodules are always lighter than the ground colour. Aperture rounded-ovoid; base cream, siphonal canal short and closed at the aperture by an extension of the outer lip.

Dimensions: The holotype measures 6.2 mm.

Distribution: Only known from Florida.

Remarks: The present species is tentatively included in *Marshallora* due to similarity with the other Caribbean species in this genus. At the beginning of this study the shells included in this taxon were placed in the variable *M. ostenta* spec. nov. Finally, both species were considered different on the basis of the following characters: *M. ostenta* almost always has a dark brown base, the protoconch has fewer whorls (see Figs. 8E, 8F in comparison with Fig. 8G), the apex is wider, the spiral threads on the protoconch are in the middle of the whorl; on the teleoconch, spiral 2 never begins before the fifth whorl, sometimes even later.

Similiphora intermedia (C. B. Adams, 1850) always has very dark colour on spiral 1, while spiral 2 is light or dark brown.

Marshallora modesta (C. B. Adams, 1850) and *M. nigrocincta* (C. B. Adams, 1839), have similar shells but in both cases they are darker brown and never whitish or cream. The protoconchs of both species are rather different, being wider at the apex and shorter (as can be seen in Figures 8H and 8I, in comparison with Fig. 8G).

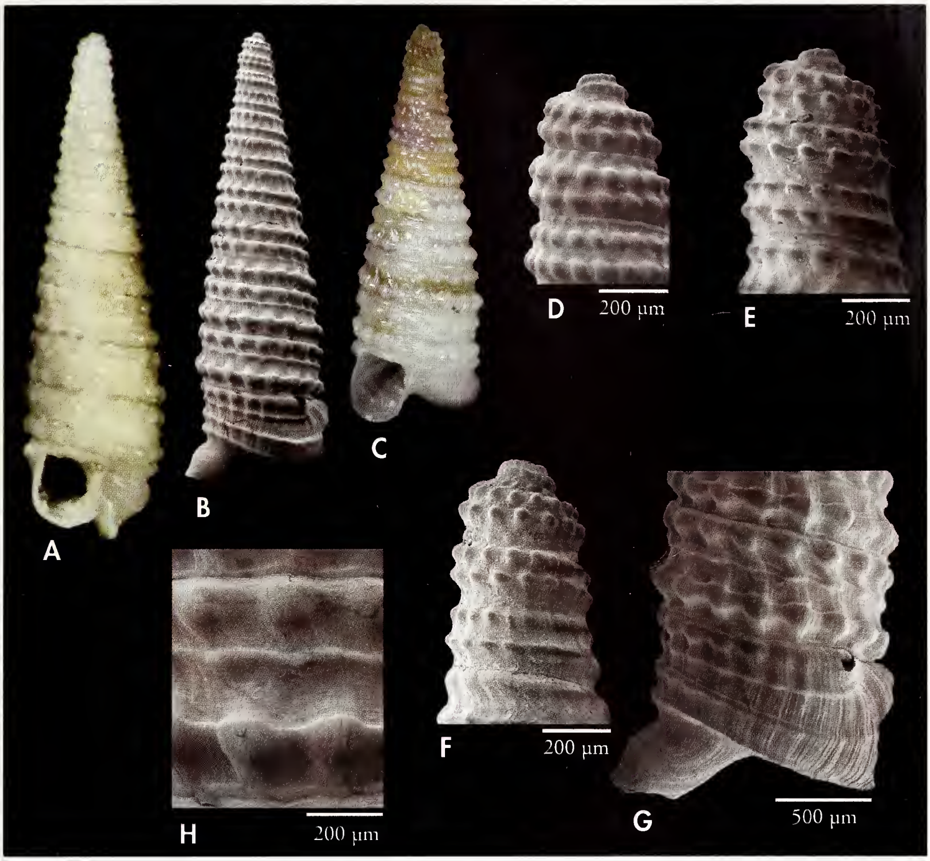

Figure 5. *Isotriphora guanahacabibes* spec. nov. A: holotype, 5.5 mm (MNCN); B: paratype, 4.7 mm (MHNS); C: paratype, 4.35 mm (IES). D-F: protoconchs of paratypes (MHNS); G: detail of the end of the last whorl, paratype in figure B; H: detail of the microsculpture.
Figura 5. Isotriphora guanahacabibes *spec. nov. A: holotipo, 5,5 mm (MNCN); B: paratipo, 4,7 mm (MHNS); C: paratipo, 4,35 mm (IES). D-F: protoconchas de paratipos (MHNS); G: detalle del final de la última vuelta, paratipo de la Figura B; H: detalle de la microescultura.*

Genus *Inella* Bayle, 1879

Ino Hinds, 1843, p. 17. Type species (subsequent designation of Jousseaume 1844: 230): *Triforis (Ino) gigas* Hinds, 1843. Recent, New Guinea.
Inella Bayle, 1879, p. 35. New name for *Ino* Hinds (not *Ino* Samsuelle, 1817).

Remarks: The type species (see MARSHALL, 1983) has a blunt and wide protoconch with between two and three whorls, each with two spiral cords; the shells included in this genus are elongate and usually have two spiral beaded cords at the beginning of the teleoconch (three exceptionally) and three on the subsequent whorls, frequently with a fourth cord appearing at the suture. MARSHALL (1983) mentioned that the limits of the genus are uncertain, and the radula has numerous small and similar teeth except the rachidian, that has symmetrical cusps.

Inella bigemma (Watson, 1880) (Figs. 9A-B, 36B)

Cerithium (Triforis) bigemma Watson, 1880. Prelim. Report., pt 5. *Journ. Linnean Soc. London*, 15: 101, sp. 2. [Type locality: 18° 38′ 30″ N, 65° 5′ 30″ W, Off Culebra Island, 713 m].

Type material: Syntype (BMNH 1887.2.9.1762) (Fig. 9A) here designated as lectotype.
Other material examined: 1 s (Fig. 9B), (BMNH 1915.12.31.199) from Irish Fishery Board.

Description: See WATSON (1881, 1886). The protoconch is unknown. Two spiral cords are present on the first whorls, subsequently with an additional smaller, less prominent cord appearing above them. About 17 whorls on the lectotype.

Dimensions: The lectotype measures 13.5 mm.

Distribution: Only known with certainty from the lectotype, Culebra Island (between Puerto Rico and Virgin Islands).

Remarks: The shell mentioned in the original description as having 0.6 inch (=15 mm) and the original figure (Fig. 36B) are coincident in size and number of whorls with the shell studied by us, and probably it is the same.

The second shell studied (Fig. 9B) has a different profile and could be a different species (BOUCHET AND WARÉN, 1993 are of the opinion that this shell is *Strobiligera brychia*). Without protoconchs it is not possible to make a correct comparison. This species is very similar to *I. torticula* (see below, in *Remarks* for that species).

This taxon is mentioned in DALL (1981, 1989), who suggested that the species *Triforis torticula* could be a variety of *T. bigemma*. As the shells are not in perfect condition and lack protoconchs, not enough information was obtained to decide if they represent different species, but the whorls seem to expand more slowly on the type of *T. torticula*, although not on the other shells studied.

Inella inflata (Watson, 1880) (Figs. 9C, 36G)

Cerithium (Triforis) inflatum Watson, 1880. Prelim. Report., pt 5. *Journ. Linn. Soc.*, 15: 103. [Type locality: 18° 38′ 30″ N, 65° 5′ 30″ W, St. Thomas, N of Culebra Island, Danish West Indies, 713 m; indicating: Habitat.- Yucatan Strait, 1170 m (Dall).].
Triforis inflatum Watson: Dall, 1881. *Bull. Mus. Comp. Zool.*, 9: 6.
Triforis (Sychar) inflata Watson: Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 249.

Type material: Syntype (BMNH 1887.2.9.1766) (Fig. 9C) here designated as lectotype.

Description: See WATSON (1881, 1886). The protoconch is pupoid and perhaps with about two whorls, the first one wider than the second. It may be about 500 µm in diameter. The teleoconch is in bad condition, but it is possible to see the two main beaded spirals, and one more near the suture. The nodules are concave above and pointed.

Dimensions: The lectotype measures 4.8 mm.

Distribution: Only known from the type locality.

Remarks: No other syntype of this species was found in other museums and the shell is nearly identical to that represented in the original figure of *I. Inflata* (Fig. 36G), for which 13 whorls are mentioned (really 12 including the protoconch) and the correct size of 4.8 mm. Therefore, probably it could be the only type specimen but, as no holotype was mentioned in the original description, this shell is here designated as lectotype. Its protoconch is very different from most others from the Caribbean area, and is therefore a differential character.

DALL (1889) placed his species *T. ibex* as a variety of *I. inflata* Watson. Both

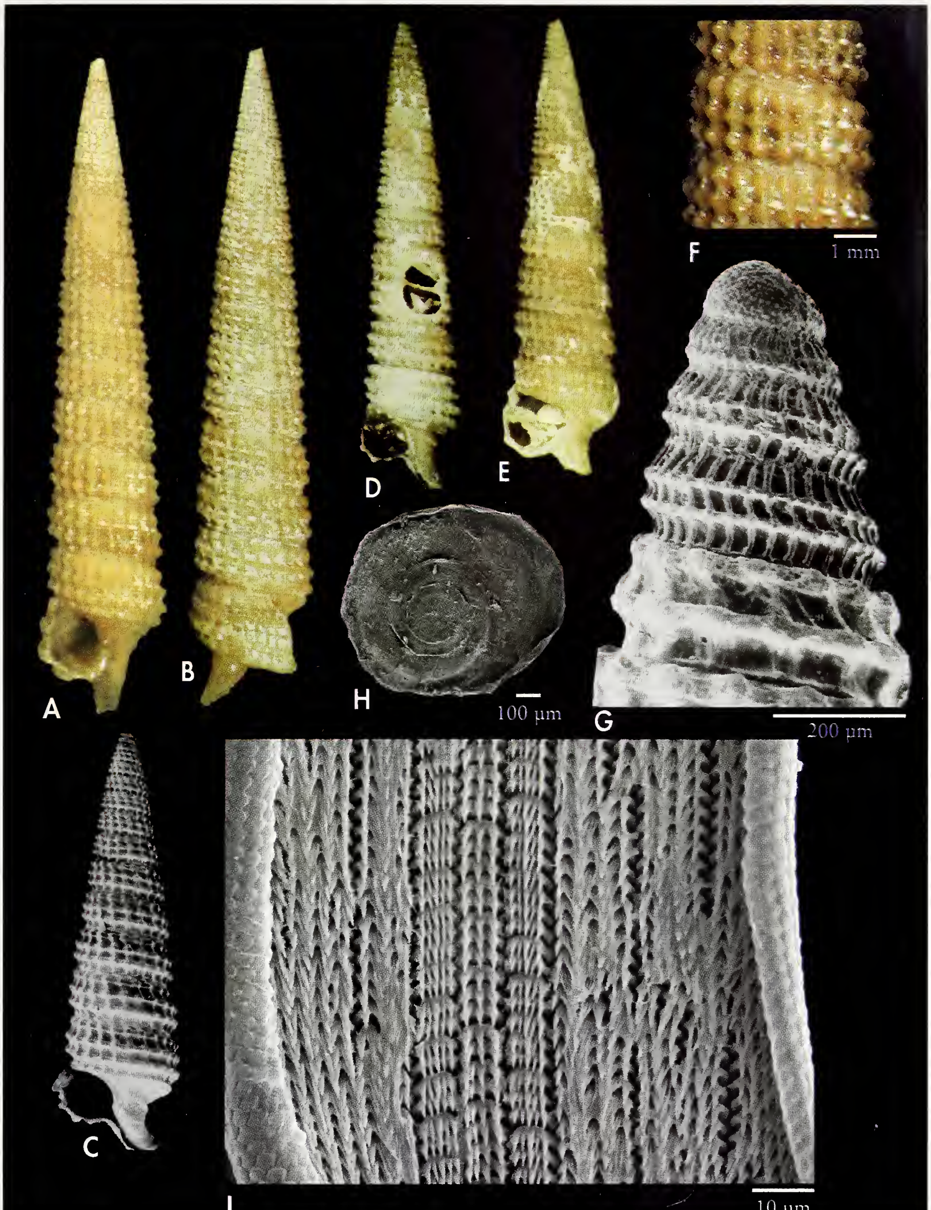

Figure 6. *Eutriphora auffenbergi* spec. nov. A, B: holotype, 21.8 mm, off Dry Tortugas, Florida (FLMNH); C: paratype, 8.4 mm, same locality (BMSM); D: paratype, 13.7 mm, Fla., USA (station 4)(MCZ 356088). E: paratype, 12.1 mm, 14 whorls, Fla., USA, 5.5 m (MCZ 356096). F: detail of sculpture of the holotype; G: protoconch of the paratype in fig. C; H: operculum (of a specimen from Palm Beach, Florida, 100-300 fms (FLMNH); I: radula (from the same specimen).
Figura 6. Eutriphora auffenbergi *spec. nov. A, B: holotipo, 21,8 mm, de fuera de Dry Tortugas, Florida (FLMNH); C: paratipo, 8,4 mm, la misma localidad (BMSM); D: paratipo, 13,7 mm, Fla., USA (estación 4) (MCZ 356088). E: paratipo, 12,1 mm, 14 vueltas, Fla., USA, 5,5 m (MCZ 356096). F: detalle de la escultura del holotipo; G: protoconcha del paratipo en la fig. C; H: opérculo (de un ejemplar de Palm Beach, Florida, 100-300 brazas (FLMNH); I: rádula (del mismo ejemplar).*

taxa do not appear to be similar: *I. ibex* lacks a protoconch and the type, with 14 whorls, is 10.4 mm; the description of *I. inflata* mentions 13 whorls and 4.8 mm, but the shell is less mature than the type specimens of *I. ibex*. Comparison of the types shows a different sculpture, the suture is deeper on *I. ibex* and the sutural threads are less prominent.

It is more difficult to distinguish it from other species of *Inell*a and this shall be done below.

Inella longissima (Dall, 1881) (Figs. 10A-G, 36D)

Triforis (Ino) longissimus Dall, 1881. *Bull. Mus. Comp. Zool.*, 9: 80. [Type locality: Not stated].
Triforis (Inella) longissima Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 246, pl. 20, fig. 10. [Habitat: Sigsbee knoll, off Havana, in 320-823 m].

Type material: One syntype, here designated as lectotype (Fig. 10A). Off Havana, Cuba 22° 9′ N 82° 21′ 30W, 175 m. Blake 1877-1878 Exped. Sta. 56 (MCZ 7381).
Other material studied: <u>Bahamas</u>: 1 f, Tamarind, Grand Bahama Island 26° 30′ 45″N, 78° 36′ 00″ W (J. Worsfold) (ANSP 368279); <u>Florida</u>: 1 j (Fig. 10F) with protoconch, off Alligator Reef Light, lower Florida Keys (J. Moore, 1965) (ANSP 312592); 1 s (Fig. 10B), 1 j, SW of Egmont Key, (D. Steger, 1966) 366-420 m (ANSP 306391); 1 s, Monroe Co., 205° off Sombrero Light, (McGinty, Jul. 1951), 335-367 m (FLMNH 249518).

Description: See Dall (1881). Shell (Fig. 10A) elongate, solid, whitish. The protoconch is not known from the syntype, but a juvenile (Fig. 10F), which could be this species, shows a paucispiral protoconch of about 400 µm, with a pupoid apex and three whorls with two spiral cords. On this juvenile, the beginning of the teleoconch has only two spirals, but after a few whorls the third very small spiral appears between them. The teleoconch in large shells can reach up to 27 or more whorls (Fig. 10B). The profile of the whorls is straight, with four spirals: spirals 1 and 3 are almost similar in size and between them is spiral 2, which is initially slightly smaller but is subsequently of similar size; very close to the suture there is one more smooth spiral cord (Fig. 10D). Spiral 3 is a little more prominent than spirals 1-2. The nodules are always rounded.

Dimensions: The lectotype measures 26.7 mm.

A larger specimen, supposedly of this species, has a more prominent spiral 3 on the final whorls (Fig. 10B) and the nodules are a little larger.

Distribution: Known from Bahamas, Florida and Cuba.

Remarks: The syntypes with this label from USNM and MCZ were examined. The problem is that the two lots apparently represent two different species. In this situation, after the description of Dall (1881) was carefully revised, it was decided to designate as lectotype the syntype in MCZ, due to the fact that the characters of this shell more closely matched the original description. In this description, the author pointed out that: "all the shells were decapitated" (which is not the case in the USNM syntype), and he only mentioned three spiral cords; furthermore, the shell designated as lectotype has characters that are more similar to those of the figure of *I. longissima* represented in Dall (1889: pl. 20, fig. 10)(Fig. 36D), and is close to 26 mm in size. The syntype in USNM (with the label *T. longissimus*) has a size of 22 mm, different to the dimensions mentioned by Dall (1881), has a perfect protoconch and has only two spirals on the first 6-7 whorls of the teleoconch; additionally, a third and fourth cord appear, but these differ from the figure in Dall (1889). Also the siphonal canal is larger. For all these differences it was considered to be a separate species, and will be described below as new (*I. pseudolongissima*). The shell from ANSP (Fig. 10B) may be the same species, but spiral 2 is very small

Figure 7. *Marshallora ostenta* spec. nov. A, B: holotype, 4.2 mm, MNCN; C: paratype, 3.6 mm (IES); D: shell, 3.9 mm, specimen destroyed for radular studies; all from Cienfuegos, Cuba; E: paratype, 3.9 mm, off Mayport, Florida (FLMNH); F, G: paratypes, 5.5 and 5.4 mm, off Big Pine Key, Florida (BMSM); H: paratype, 3.5 mm, off St. Augustine, St. Johns Co., Florida (USNM); I: paratype, 5.5 mm, off Big Pine Key (CHL); J: paratype, 5.5 mm, Florida (FLMNH); K: paratype, 5.3 mm, Florida (FLMNH); L: radula from a specimen from Cienfuegos; M: radula from a specimen from Florida; N: operculum, from Cienfuegos.

Figura 7. Marshallora ostenta *spec. nov. A, B: holotipo, 4,2 mm, MNCN; C: paratipo, 3,6 mm (IES); D: concha, 3,9 mm, ejemplar destruido para estudios radulares; todos de Cienfuegos, Cuba; E: paratipo, 3,9 mm, fuera de Mayport, Florida (FLMNH); F, G: paratipos, 5,5 y 5,4 mm, fuera de Big Pine Key, Florida (BMSM); H: paratipo, 3,5 mm, fuera de St. Augustine, St. Johns Co., Florida (USNM); I: paratipo, 5,5 mm, fuera de Big Pine Key (CHL); J: paratipo, 5,5 mm, Florida (FLMNH); K: paratipo, 5,3 mm, Florida (FLMNH); L: rádula de un ejemplar de Cienfuegos; M: rádula de un ejemplar de Florida; N: opérculo, de Cienfuegos.*

from the first teleoconch whorls, and on the final whorls spiral 3 is more prominent than on the lectotype. However, as these minor differences probably only indicate some variation in the species, the shell has been kept in this taxon.

In spite of there being no information about the protoconch of the lectotype of this species, it has been considered to belong to the genus *Inella* on the basis of the protoconch present on a juvenile, which probably represents the same species.

Inella pseudolongissima Rolán and Fernández-Garcés spec. nov. (Figs. 11 A-H)

Type material: Holotype (Fig. 11A), a paratype (Fig. 11D) and a fragment (USNM 87316: syntypes of *Triforis longissimus*) from the type locality; 1 paratype (Fig. 11E), 26° 40′ N (M.E. Powlus, July 1960) (McGinty coll.) 77 m, (FLMNH 171183); 1 paratype (Fig. 11G), Hillsborough Co., Tampa, Florida, West of Egmont Key (J. Moore, Jun. 1962) (McGinty coll.) 366 m (FLMNH 158180).
Type locality: Cuba, off Havana, 823 m.
Etymology: The specific name alludes to the similarity with *I. longissima*, with which this species was confused.

Description: Shell (Figs. 11A, 11D, 11E, 11G) very elongate, irregularly white or creamish. Protoconch (Figs. 11B, 11F, 11H) multispiral with nearly 4 whorls, almost 1 mm in height and with a diameter of about 500 µm, sculptured with 2 spiral cords that are more evident on the last whorls; these two cords are unapparent or only insinuated on the first two whorls. Teleoconch with between 18 and 24 whorls, the first whorls with two beaded spiral cords (spirals 1 and 3), the nodules being rounded; below, on whorls 3-4, a small, very narrow cord (spiral 2) appears between them; this new cord is always smaller than the other two and closer to the upper one; spiral 3 subsequently increases in size and is very clearly the largest on the last 4-5 whorls, the other two being smaller; also an additional small, unbeaded cord appears at the suture. Axial ribs are almost not appreciable; the growth lines are prosocline. Aperture rhomboid, siphonal canal short and open.

The colour of the holotype is totally white. Paratypes are cream with some areas of light brown.

Dimensions: The holotype measures 22.0 mm.

Distribution: Known from Florida and Cuba.

Remarks: *I. pseudolongissima* may be distinguished from *I. longissima* by teleoconch sculpture, the latter species having three cords of equal size on most of the spire. Also spiral 2 appears on the first whorls of *I. pseudolongissima* but on about the seventh whorl in *I. longissima*. The protoconch of *I. longissima* has three whorls with two well defined cords, while the protoconch of *I. pseudolongissima* has four smooth whorls, and the apex is smaller.

For differentiation from other close species, see below.

Inella noduloides spec. nov. Rolán and Fernández-Garcés (Figs. 12 A, B)

Type material: Holotype (Figs. 12A, 12B) in ANSP (374588).
Type locality: Tamarind, Grand Bahama Island, Bahamas 26° 30′ 45″N, 78° 36′ 00″W, 500 m (J. Worsfold, May, 1985).
Etymology: The name alludes to the prominent nodules of the whorls.

Description: Shell (Figs. 12A, 12B) small, subcylindrical, elongate, whitish and solid. Protoconch with a pupoid apex of about 380 µm diameter and 3 whorls, each with two smooth spiral cords; the lower cord becomes more prominent near the end, where another smooth, less prominent cord appears above the other two, very

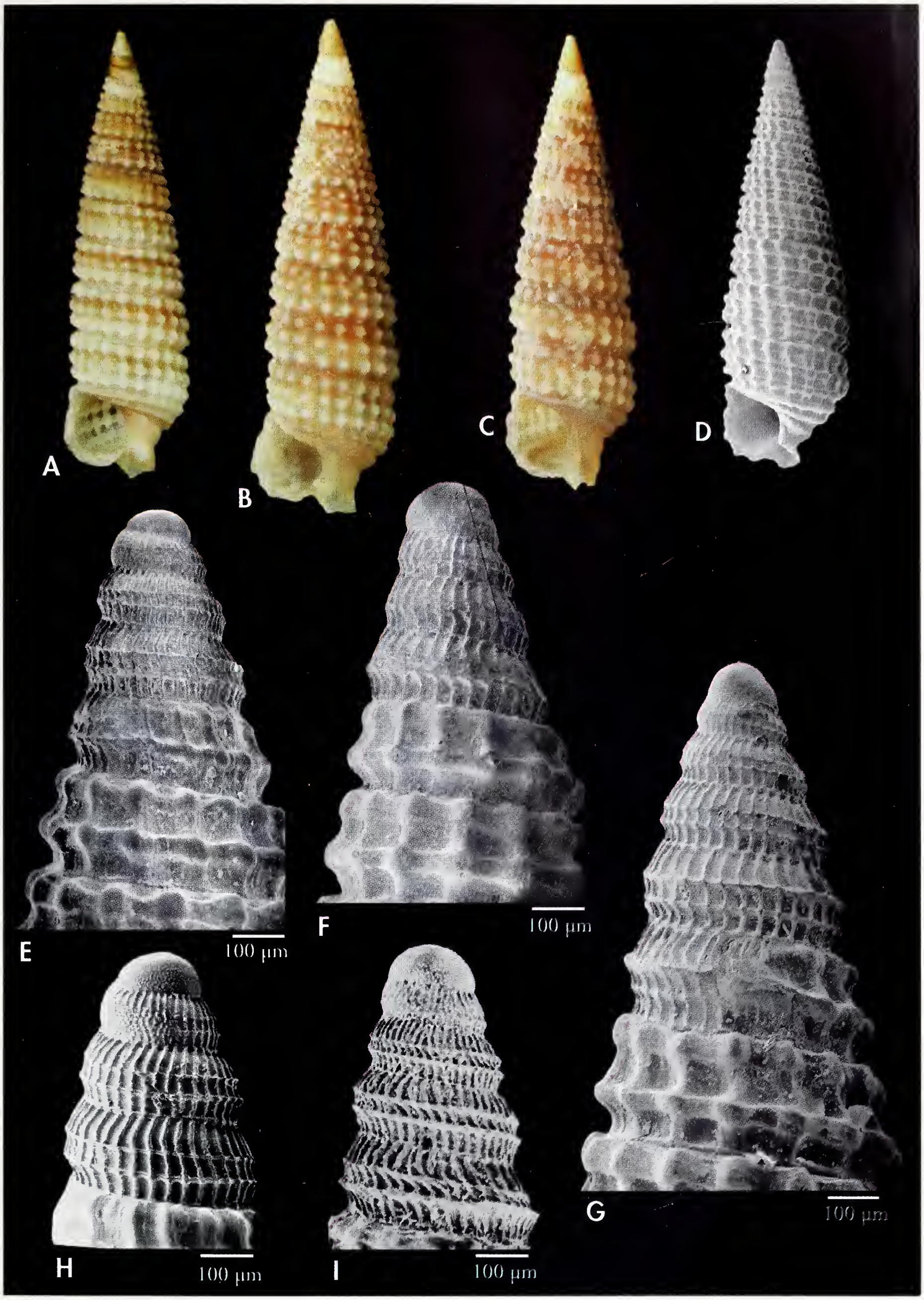

Figure 8. A-D. *Marshallora apexdiversus* spec. nov. A: holotype, 6.2 mm, Florida (FLMNH); B-D: paratypes, 6.9, 6.5, 4,6 mm, Florida (FLMNH). E-I. Protoconchs of *Marshallora* species. E, F: *M. ostenta*, Florida; G: *M. apexdiversus*, Florida; H: *M. modesta*, Cuba; I: *M. nigrocinta*, Cuba.
Figura 8. A-D. Marshallora apexdiversus *spec. nov. A: holotipo, 6,2 mm, Florida (FLMNH); B-D: paratipos, 6,9, 6,5, 4,6 mm, Florida (FLMNH). E-I. Protoconchas de diferentes especies de* Marshallora. *E, F:* M. ostenta, *Florida; G:* M. apexdiversus, *Florida; H:* M. modesta, *Cuba; I:* M. nigrocinta, *Cuba.*

close to the suture; under high magnification numerous tubercles can be seen. On the first two whorls of the teleoconch there is one prominent cord in the middle and another smaller one below the suture; both have prominent nodules numbering about 10-11 per whorl. On the subsequent whorls there is a small nodulous cord below the suture with another small, slightly nodulous one below it; these are followed by the most prominent cord, with rather sharply pointed nodules, and one more below it, close to the lower suture. The aperture is rounded but irregular, as the shell is juvenile.

Dimensions: The holotype measures 2.1 mm.

Distribution: Only known from the type locality.

Remarks: No other species has these characters, with one spiral cord with very prominent nodules and 3 weaker spirals. The closest species may be the new species *I. harryleei* (see below).

Inella apexbilirata spec. nov. Rolán and Fernández-Garcés (Figs. 12C-E)

Type material: Holotype (Fig. 12C) (ANSP 367841); 4 paratypes (ANSP 367840) (Fig. 12D). All from the type locality.

Type locality: Lucaya, Grand Bahama Island, Bahamas 26° 29′ 45″ N, 78° 37′ 15″ W (J. Worsfold), 300 m.

Etymology: The specific name alludes to the beginning of the protoconch, with two spirals commencing from the nucleus.

Description: Shell (Figs. 12C, 12D) small, subcylindrical, elongate, shiny, whitish and solid. Protoconch (Fig. 12 E), shining white, with a very small nucleus, a diameter of nearly 400 µm and a height of about 660 µm, 3 whorls with two smooth spiral cords which begin just on the nucleus. The teleoconch has two main beaded cords, the lower one slightly larger; one smooth smaller cord occurs at the suture. The nodules on the main spirals are pointed and cut at the middle. The axial ribs which connect the nodules are scarcely evident and are slightly prosocline. There are about 13 on the first whorls and 17 on the last. Aperture ovoid, siphonal canal very short and open.

Dimensions: The holotype measures 3.5 mm.

Distribution: Only known from the type locality.

Remarks: The species with two main spirals are the following:

I. bigemma and *I. inflata* have whorls that increase quickly in width, and the latter species has a pupoid protoconch.

I. harryleei spec. nov. (see below) has spirals 1 and 3 at the beginning, spiral 2 appearing later and being smaller.

I. ibex has the same number of nodules in spite of being a more developed shell. Besides the two main spirals there is only one more near the suture.

I. torticula has three spirals on the first whorls and 4-5 on the last ones.

I. colon has two spirals but equidistant from both sutures.

I. compsa also has two main spirals, with spiral 1 being smaller; its protoconch is unknown, but the whorls on this shell increase rapidly in width.

I. enopla and *I. meteora* have a very different wide, pupoid protoconch.

Inella pinarena Espinosa, Ortea and Fernández-Garcés, 2007 (Figs. 12F-J)

Inella pinarena Espinosa, Ortea and Fernández-Garcés, 2007. *Avicennia*, 19: 73, fig. 46. [Type locality: Yemayá, Maria la Gorda, Guanahacabibes, Pinar del Rio, Cuba].

Description: See Espinosa, Ortea and Fernández-Garcés (2007). Shells (Figs. 12F. 12G), are shown in SEM photographs. We add some informations on

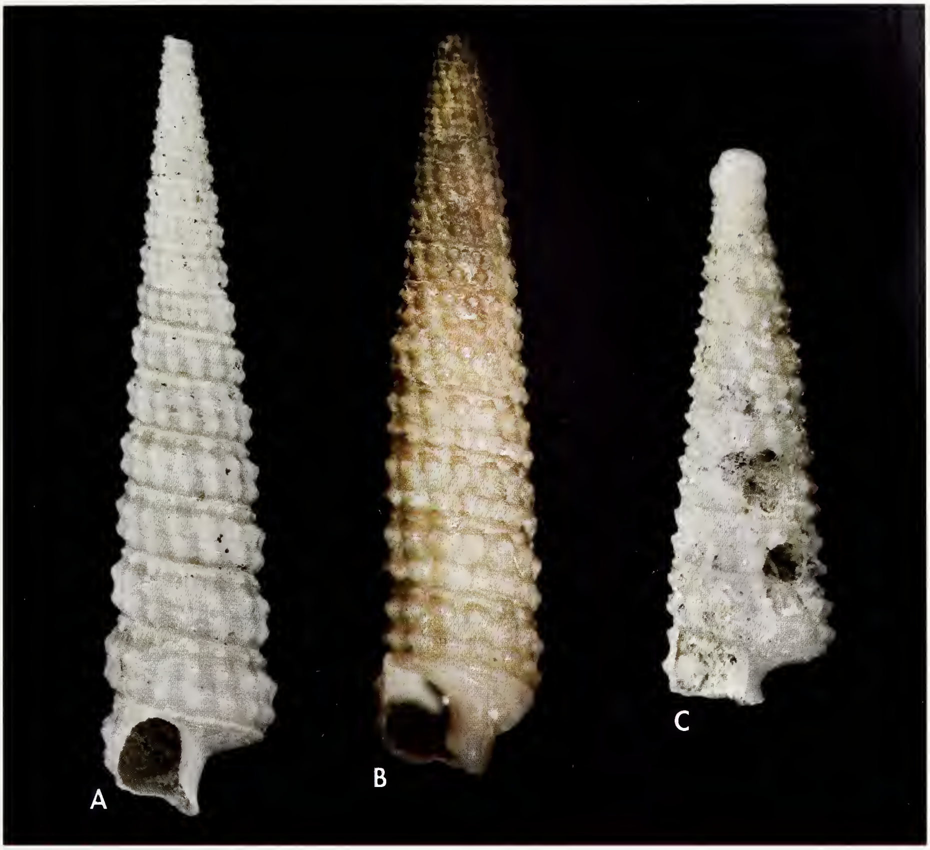

Figure 9. A. *Cerithium bigemma* Watson, 1880. lectotype, 13.5 mm (BMNH). B. *Inella bigemma*, shell, 13.0 mm (BMNH). C. *Cerithium inflatum* Watson, 1880, lectotype, 4.8 mm (BMNH).
Figura 9. A. Cerithium bigemma *Watson, 1880. lectotipo, 13,5 mm (BMNH). B.* Inella bigemma, *concha, 13,0 mm (BMNH). C.* Cerithium inflatum *Watson, 1880, lectotipo, 4,8 mm (BMNH).*

the protoconch (Figs. 12H, 12I): small tubercles are present on the protoconch surface between the spiral ribs. The microsculpture of the teleoconch (Fig. 12J) is formed by very small spiral striae, more evident on the subsutural part.

Distribution: Only known from the type material.

Remarks: This species was recently described but, in the original description, only one optical photo was presented. More details on the shell, protoconch and microsculpture are here illustrated, showing that there is no similarity with other species of the group in the Caribbean.

Inella harryleei spec. nov. Rolán and Fernández-Garcés (Figs. 13A-K)

Type material: Holotype (Fig. 13A) and 2 (s) paratypes in FLMNH; one more in BMSM (Fig. 13B) all *ex* CHL; another in CHL (Fig. 13C); all from the type locality. Other paratypes: 9 j and f, 28° 4.57′ N, 90° 59.99′ W, 87.9 m (E.F. Garcia/*Pelican*, 9/1-5/01) (CHL); 1 j, from the same locality (USNM); 2 j more 26° 06.866′ N, 91° 02.418′ W, off Louisiana, 59-65 m (E.F. Garcia/*Pelican*, 6/30/01)(CHL);

1 f, off Alligator Reef Light, Lower Florida Keys (J. Moore, 1965) (ANSP 312593); 3 s, SW of Egmont Key, Florida (D. Steger, 1966) 366-420 m (ANSP 306391); 3 j, W of Tampa Bay, Florida (Richardson) 500 m (ANSP 335492); 1 s, Hillsborough Co., 110 miles SW of Egmont Key, Florida (D. Steger, 1953) 165 m (FLMNH 151609); 1 s (Fig. 13D), Hillsborough Co., SW of Egmont Key, Florida (J. Moore, 1967) 46 m (FLMNH 158178).

Other material examined: 2 f, Stn. 15, Florida (MCZ 356092) which are not in sufficiently good condition to examine all their characters and attribute them with certainty to this species; 1 f (A.M. Norman coll.) (Blake Expedition), West Indies (BMNH acc. n° 2283).

Type locality: off Dry Tortugas, Monroe Co., Florida, 90 m (J. Moore/ *Cavalier*, 1992).

Etymology: The species is named after Harry G. Lee, American malacologist who lent us the material on which this species is based.

Description: Shell (Figs. 13A-13D) elongate, very large for the genus, solid, well sculptured. Protoconch (Figs. 13G-13K) with between 3 and 3 $^{1}/_{4}$ whorls, bulbous, white, with barely discernible separation from the teleoconch, the first whorl smooth and the next with two spiral cords that are sometimes a little irregular; on the last whorl the lower cord is more prominent, and the upper one may divide in two. The teleoconch has many whorls, 22 in the holotype and 17 in a paratype (Fig. 13B). The first whorls have two spiral nodulous cords (spirals 1 and 3), connected by very narrow prosocline ribs; below, around the fourth or fifth whorls, spiral 2 appears between those cords and remains very narrow for several whorls; after the tenth whorl spiral 3 becomes a little larger, and on the subsequent whorls it is more clearly different and prominent (Fig. 13E). Spiral 2 strengthens but continues to be the smallest cord until the end. The suture is very deep. The axial ribs are slightly prosocline. Aperture (Fig. 13F) ovoid, siphonal canal narrow and large, dark in colour. Shell colour light brown or white with irregular brown axial flammules.

Dimensions: The holotype measures 18.3 mm. The paratypes are smaller.

Distribution: Only known from the type locality.

Remarks: The present species must be compared to and differentiated from the following:

I. longissima is uniformly white and more cylindrical, having three equal spiral cords throughout most of the spire, and another smaller one on the suture which is relatively shallower; the shell sculpture is very similar from the beginning to the end with only a little more prominence of the lowermost cord.

I. pseudolongissima spec. nov. is white with 4 cords, the upper one smooth at the suture, the following two very small, and only the lowermost is clearly prominent; the suture is not deep; the protoconch has more whorls.

I. noduloides spec. nov. has one prominent beaded spiral cord with three more smaller ones which are absent from the first whorls of the teleoconch of *I. harryleei*.

Other elongate deep water species are *Inella colon* Dall, 1881, and *I. ibex* Dall, 1881; both have only two spiral beaded cords per whorl.

Inella aff. *harryleei* (Figs. 14A, B)

Material examined: 1 s, Manatee Co., West of Anna Maria Key, Florida (J. Moore, 1961) (McGinty coll.) 55 m (FLMNH 158177).

Remarks: The specimen studied is in perfect condition and appears rather similar to *I. harryleei* spec. nov., but it differs in the following characters: a more pointed protoconch, with about two whorls and an angulation on the second whorl, without visible cords; on the teleoconch, spiral 1 is not larger than spiral 2, but is less prominent; on the base, below spiral 3, there is only one

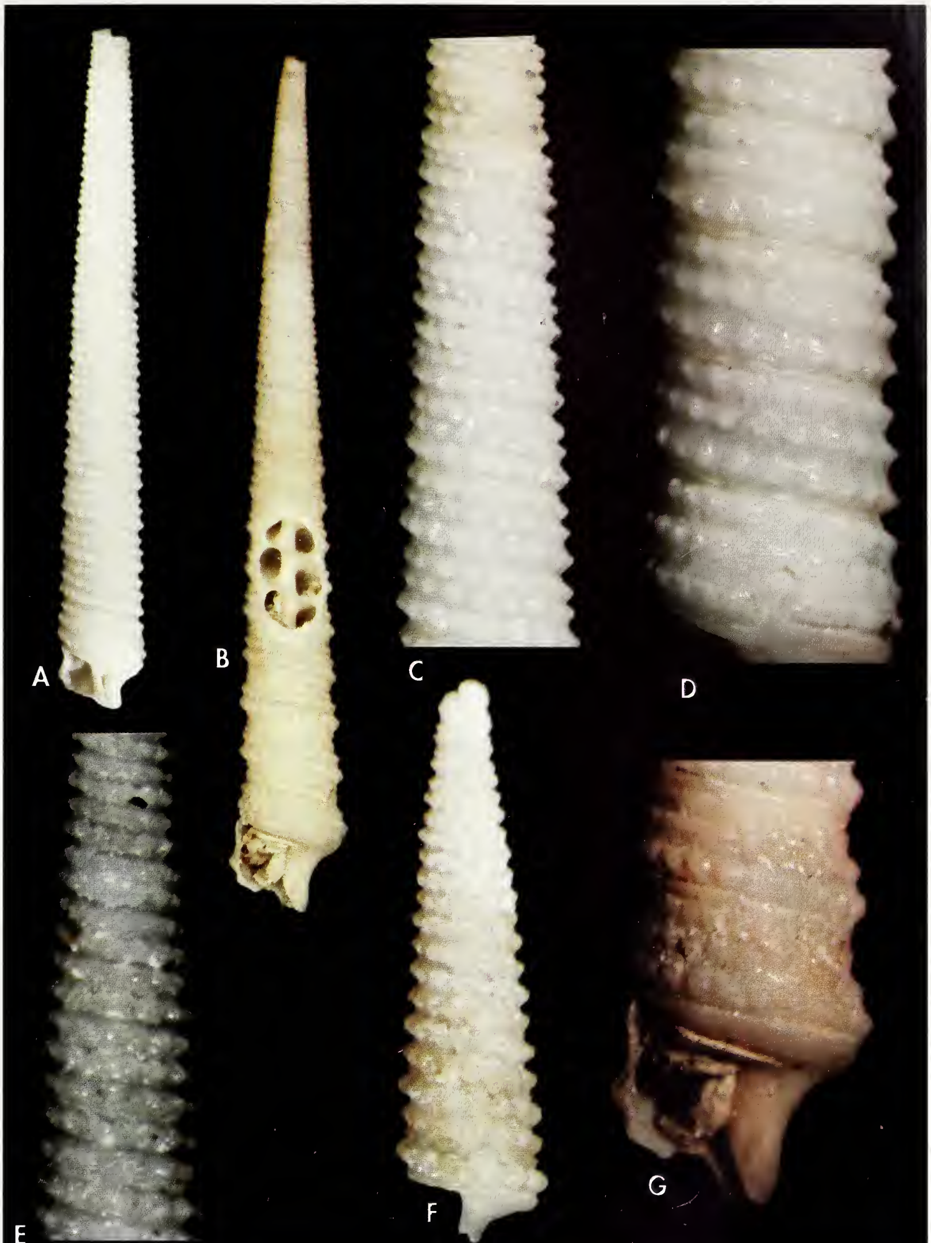

Figure 10. *Inella longissima* (Dall, 1881). A: lectotype, 26.7 mm, off Havana, 175 m (MCZ 7381); B: shell, 27.9 mm (ANSP); C, D: detail of the spire of lectotype; E: fragment of first whorls, 6.3 mm (ANSP); F: juvenile with protoconch (ANSP 312592); G: detail of last whorls of the shell from Figure B.

Figura 10. Inella longissima *(Dall, 1881). A: lectotipo, 26,7 mm, fuera de La Habana, 175 m (MCZ 7381); B: concha, 27,9 mm (ANSP); C, D: detalle de la espira del lectotipo; E: fragmento de las primeras vueltas, 6,3 mm (ANSP); F: juvenil con protoconcha (ANSP 312592); G: detalle de las últimas vueltas de la concha de la Figura B.*

smooth cord and another very small one immediately below. The siphonal canal is shorter.

Dimensions: The only shell studied measures 28.8 mm.

All these differences indicate that this shell may represent a separate species, but they are not enough to justify naming it. Additional material is required.

Inella triserialis (Dall, 1881) (Figs. 14C-E, 36E)

Triforis (Inella) triserialis Dall, 1881. *Bull. Mus. Comp. Zool.*, 9: 84. [Yucatan Strait, 640 fms (1171 m). Off Cape San Antonio, 640 fms (1171 m). Station 2, 805 fms (1472 m)].

Triforis (Inella) triserialis Dall, 1881. In Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 249, pl. 20, figs. 5a, 6a.

Triphora aspera auct. non Jeffreys, 1885.

Type material: Two syntypes (USNM 87319), one of them (Fig. 14C) measuring 6.4 mm is here designated as lectotype; the other shell (5.6 mm) would be a paralectotype (Fig. 14D). Both from Cape San Antonio, Cuba, 1170 m; probably, 1 syntype (BMNH Acc. nº 2283), off Havana, 823 m (in very bad condition).

Other material studied: 1 j, SW of Egmont Key, Florida (Steger, 1966) 366-421 m (ANSP 306391).

Description: See Dall (1881). Protoconch paucispiral (Fig. 14E), wide, with about 3 whorls which have two spiral cords, the apex depressed and smooth. The teleoconch begins with three spiral nodulous cords, spiral 2 being smaller and closer to spiral 1. On the following whorls spiral 1 increases in size, with nodules that are larger than those on the other cords and are cut at the middle. These differences continue up to the end of the shell.

Dimensions: The lectotype measures 6.4 mm.

Distribution: Known from Yucatán (Mexico) and Cuba.

Remarks: As with other taxa, the syntype material found in USNM and MCZ has been examined. The material from USNM is coincident in protoconch and teleoconch sculpture with the description of Dall (1881) and with one of the figures in Dall (1898: plate 20, fig. 5a) (Fig. 36E) but not with the other figure (Dall, 1898: plate 20, fig. 6a), which seems to be a different species with a sharply pointed apex. The size of the lectotype is slightly smaller than that mentioned in the original description (8.25 mm), but it may be that this type could be partially broken. The material from MCZ seems to be what Dall named as var. *intermedia* (see below).

Dall (1989: 246) considered this taxon in relation with *Triphora aspera* Jeffreys, 1885 (preoccupied, renamed *Triphora brychia* Bouchet and Guillemot, 1978; assigned to genus *Strobiligera* Dall, 1924 by Bouchet and Warén, 1985). He therefore referred to *Triforis (Inella) triserialis* var. *aspera* Jeffreys, 1885, which perhaps can correspond with the figure previously mentioned (Fig. 36E). A syntype of Jeffreys' taxon (Fig. 14F, BMNH 85.11.5.2673) has been examined, and is here designated as lectotype. It is a larger and sharply pointed shell with a multispiral protoconch, and there is no indication that this species occurs in the Caribbean.

I. triserialis is different from most of the Caribbean species referred to in this work, mainly due to its spiral 1 having larger nodules. Comparison will be made in the *Remarks* of some species described below (such as *I. sarissa*).

Inella intermedia (Dall, 1881) (Figs. 14G-J, 36F)

Triforis intermedius Dall, 1881. *Bull. Mus. Comp. Zool.*, 9: 85. [Yucatan Strait, 1170 m; off Cape San Antonio, 1170 m; station 2, 1472 m].

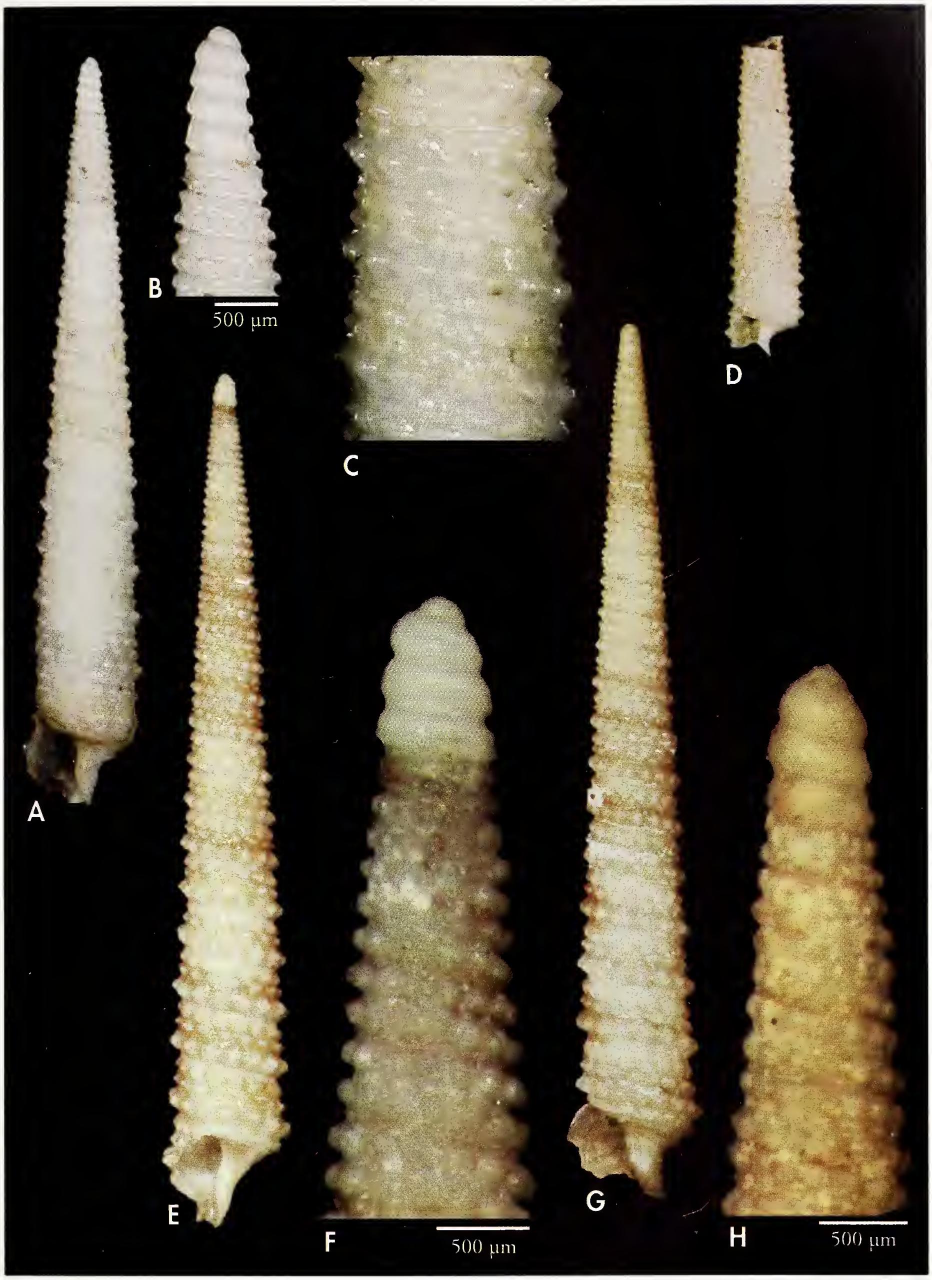

Figure 11. *Inella pseudolongissima* spec. nov. A: holotype, 22.0 mm, off Havana, 823 m (USNM); B: protoconch of the holotype; C: detail of the spire; D: paratype, 10.4 mm (USNM); E: paratype, 18.5 mm (FLMNH); F: protoconch of this paratype; G: paratype, 23.4 mm (FLMNH); H: protoconch of this paratype.

Figura 11. Inella pseudolongissima *spec. nov. A: holotipo, 22,0 mm, fuera de La Habana, 823 m (USNM); B: protoconcha del holotipo; C: detalle de la espira; D: paratipo, 10,4 mm (USNM); E: paratipo, 18,5 mm (FLMNH); F: protoconcha de este paratipo; G: paratipo, 23,4 mm (FLMNH); H: protoconcha de este paratipo.*

Triforis triserialis var. *intermedia* Dall, 1881. In Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 287, plate 20, fig. 8. [Habitat: 805 fms (1473 m). Barbados, 183 m].
Triphora clenchi Aguayo, 1935. Unnecessary replacement name *pro Triforis intermedius* Dall, 1881.

Type material: Syntype (Fig. 14G) here designated as lectotype (MCZ 7384) (off Cuba, Yucatan Strait and Cape San Antonio. Depth: 1171 m. Blake 1877-1878 Exped.); one paralectotype (Fig. 14H)(MCZ 7382) (Havana, off Morro Light. Depth: 1473 m. Blake 1877-1878 Exped.). Both shells were labeled *T. triserialis*.

Description: See Dall (1881). No protoconch was known and the author refers to "nucleus missing". Two spirals of similar strength (spirals 1 and 3) are present on the first whorls of the shell; spiral 2 appears below and is clearly smaller up to near the end of the spire, where the three spirals are almost similar in size (Fig. 14I). Axial ribs prosocline, and the nodules are spherical.

Dimensions: The lectotype measures 7.9 mm.

Distribution: From Yucatán, Mexico, Barbados and Cuba.

Remarks: The lectotype here selected is very similar to the shell represented in Dall (1989: pl. 20, fig. 8) (Fig. 36F) but it is not coincident with the description, which refers to a size of 11 mm and 23 whorls; also the figure does not agree with the description, because in spite of the fact that a height of 11 mm is mentioned, there are not more that 15-16 whorls. The shell here selected as lectotype is only 7.9 mm and has 12 whorls, and it may be the original shell which lost some part of the spire. Anyway, it must be kept as lectotype in order to attain nomenclatural stability. The paralectotype is 7.2 mm and has about 13 whorls (MCZ 7382).

The name *Triphora triserialis clenchi* Aguayo, 1935 is an unnecessary replacement name for *Triforis intermedius* Dall, 1881 (which is the same taxon as *Triforis triserialis* var. *intermedia* Dall, 1881 (in Dall, 1889)). This is due to the fact that this name is not preoccupied by *Cerithium intermedium* C. B. Adams, 1850; initially both belonged in different genera and finally the first one is placed in *Inella* and the second was recently placed by Rolán and Fernández-Garcés (1995) in the genus *Similiphora* Bouchet, 1985.

Lack of knowledge of the protoconch is a problem when comparing this species to others from the Caribbean. Basing this comparison on the teleoconch, the following species must be taken into account:

Inella longissima has a more cylindrical, more elongate shell, spiral 2 is of similar size to the other two spirals on most of the spire, while in *I. intermedia* it is always smaller.

Inella pseudolongissima spec. nov. has spiral 3 more prominent and with larger nodules.

Inella harryleei spec. nov. has a typically deep suture, spiral 3 being the most prominent, and spiral 1 is also larger than spiral 2, these differences being maintained to the end of the shell.

Inella triserialis has spiral 1 more prominent and with larger nodules.

Inella ibex (Dall, 1881) (Figs. 14K-M, 36G)

Triforis ibex Dall, 1881. *Bull. Mus. Comp. Zool.*, 9: 86. [Type locality: off Cape San Antonio, 1171 m; Yucatan Strait, 1171 m; Sigsbee, off Havana, 823 m].
Triforis (Sychar) inflata var. *ibex* Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 249, pl. 20, fig. 12b.

Type material: A syntype (f) of 10.4 mm here designated as lectotype (Fig. 14K), off Cuba, Yucatan Strait and Cape San Antonio, 1171 m (MCZ 7391); another syntype, now paralectotype, f of 7.7 mm, off Havana, Cuba 823 m (MCZ 7392). Another paralectotype (Fig. 14L) (USNM 87313), off San Antonio, Cuba, 1189 m.

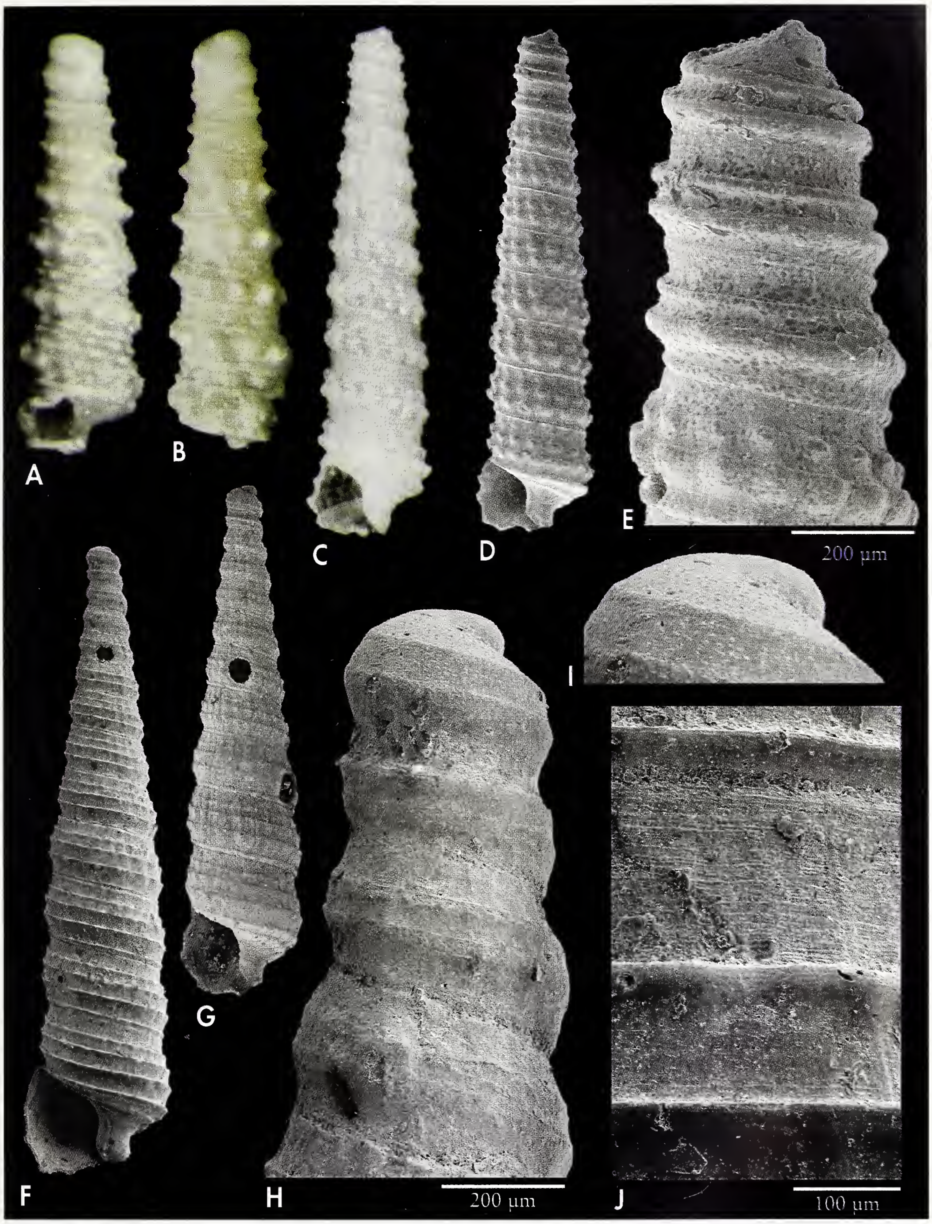

Figure 12 A, B. *Inella noduloides* spec. nov. holotype, 2.1 mm, Grand Bahama Island (ANSP). C-E. *Inella apexbilirata* spec. nov. C: holotype, 3.5 mm, Grand Bahama Island (ANSP); D: paratype, 3.2 mm, Grand Bahama Island (ANSP); E: protoconch of the paratype. F-J. *Inella pinarena* Espinosa, Ortea and Fernández-Garcés, 2007. F: paratype, 6.0 mm (CFG); G: shell, 5.0 mm (MHNS); H: protoconch of the paratype; I: detail of the protoconch; J: microsculpture.

Figura 12. A, B. Inella noduloides *spec. nov. holotipo, 2,1 mm, Grand Bahama (ANSP). C-E.* Inella apexbilirata *spec. nov. C: holotipo, 3,5 mm, Grand Bahama (ANSP); D: paratipo, 3,2 mm, Grand Bahama (ANSP); E: protoconcha del paratipo. F-J.* Inella pinarena *Espinosa, Ortea and Fernández-Garcés, 2007. F: paratipo, 6,0 mm (CFG); G: concha, 5,0 mm (MHNS); H: protoconcha del paratipo; I: detalle de la protoconcha; J: microescultura.*

Type locality: The three localities mentioned in the original description are written on the label of the lectotype, and hence there is no exact information about which locality applies to this type.

Description: See DALL (1881). The original description mentions a nucleus twice as large as that of *I. colon*, smooth, inflated, rounded on top, larger than the succeeding nuclear whorl, which has two inconspicuous narrow keels which are wavy and almost tuberculate at first, and merge almost imperceptibly into the usual sculpture of the shell. The type material studied has no protoconch, which obviously was lost. The most important characters of the teleoconch are: shell (Figs. 14K, 14L) with two rows of nodules throughout the spire and with one more, smaller and not nodulous, occurring at the suture at the end the spire (Fig. 14M). The nodules are cut at the middle. The axial ribs are scarcely appreciable and slightly prosocline.

Dimensions: The lectotype measures 10.4 mm.

Distribution: Known from Yucatan (Mexico) and Cuba.

Remarks: *Triforis ibex* is the type species of the genus *Strobiligera* Dall, 1924. The problem is that we have no image or a good description of the protoconch of this species, and the original description allows us to think that the protoconch is almost smooth, the first whorl wider than the second and with two whorls, which is typical of a protoconch of an *Inella* species. In this case; *Strobiligera* could be a synonym of *Inella*.

The assignment of this species to the genus *Inella* is tentative, The lectotype here designated is similar to the shell represented in DALL (1889, pl. 20, fig. 12b) (Fig. 36G) and also its dimensions are closer to those referred to in the original description.

Comments on the differences of *I. ibex* from other species with two spiral beaded cords can be seen below in *I. colon*, which is the most similar species.

Inella torticula (Dall, 1881) (Figs. 15, 36H)

Triforis torticulus Dall, 1881. *Bull. Mus. Comp. Zool.*, 18: 82. [Type locality: Yucatan Strait, 1170 m].
Triforis (Sychar) torticula Dall, 1881. In DALL, 1889. *Bull. Mus. Comp. Zool.*, 18: 249, pl. 20, fig. 11b.

Type material: One syntype (Fig. 15A) (f) here designated as lectotype, 6.7 mm, off Cuba, Yucatan Strait, 1171 m, Blake 1877-1878 Exped. (MCZ 7390); the syntypes in USNM have been lost (Ellen Strong, pers. comm.).
Other material examined: 1 f (Fig. 15B) (labeled as *Triphora bigemma* Watson, 1880), 9.7 mm, 9 whorls, Yucatan Strait, 1171 m (MCZ 7388); 1 s (Figs. 15C, 15D), 25.0 mm, Straits of Florida, 1000-1200 m (CHL).

Description: See DALL (1881). The most important characters are: 4 spirals, the lowermost spiral 4 very narrow and very close to the suture; spiral 1 smaller than spirals 2 and 3, which are equal in size and prominence. Colour whitish. The study of an almost complete adult shell (without protoconch) with 17.5 whorls (Figs. 15C, 15D) (CHL), allows us to add some information: at the beginning of the shell there are only three spirals, almost similar in size, but the uppermost slightly smaller; later, the differences between spiral 1 and spirals 2-3 are more evident, and at same time spiral 4 appears; on about whorl 13 (on this shell) the uppermost spiral 1 is divided in two, there being 5 spirals at the end of the shell (Fig. 15E). The ribs are orthocline.

Dimensions: see below.

Distribution: Known from deep water off Florida and Cuba.

Remarks: The placement of this species in the genus *Inella* is tentative, as the protoconch and the aperture are not known.

The syntype in MCZ (Fig. 15A), here designated as lectotype, is a shell fragment that seems to be the one figured in

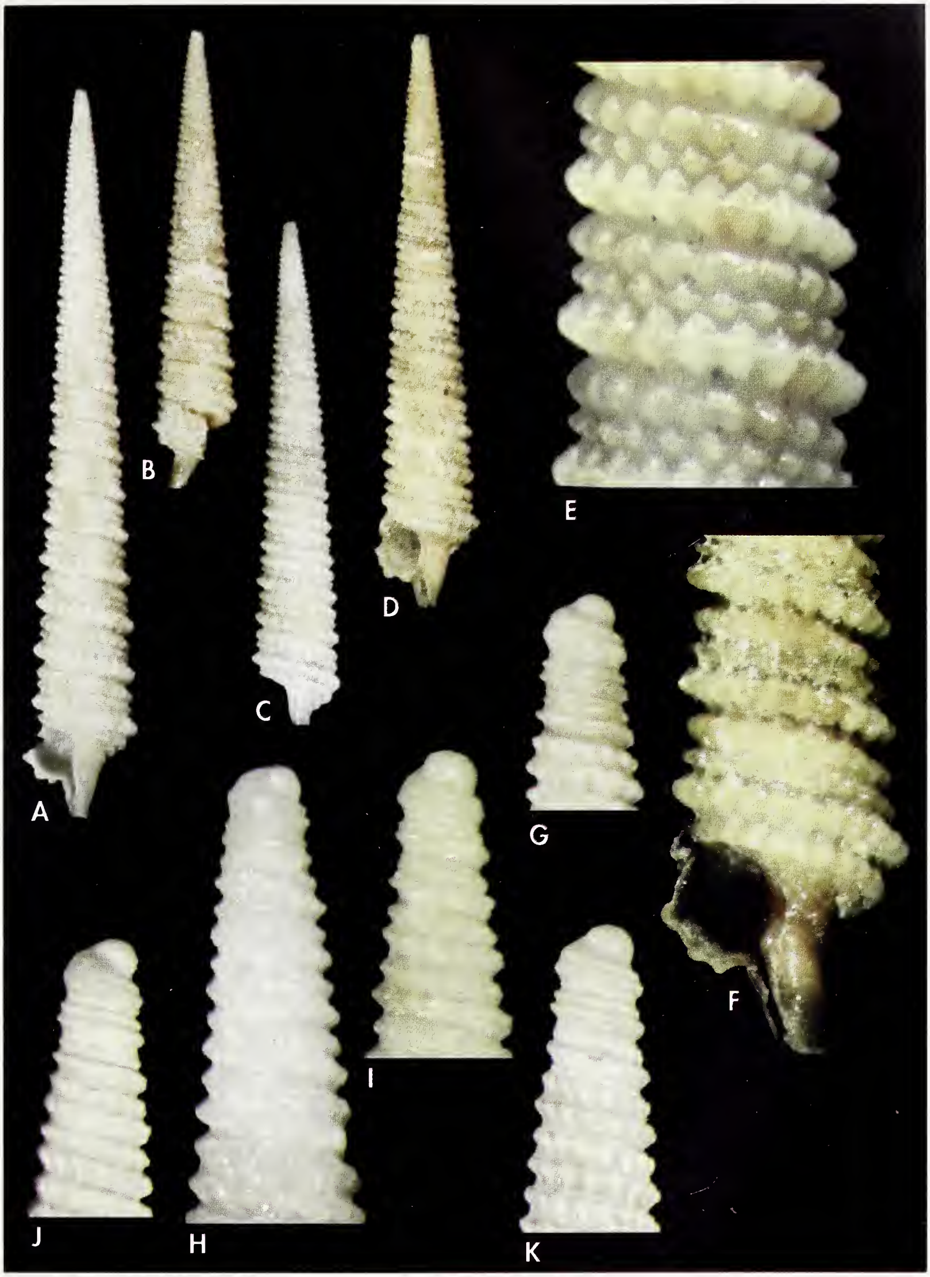

Figure 13. *Inella harryleei* spec. nov. A: holotype, 18.3 mm, off Dry Tortugas, 90 m (CHL); B: paratype 11.7 mm (BMSM); C: paratype, 12.8 mm (CHL); D: paratype, 14.6 mm (FLMNH). E: detail of the spire of the holotype; F: detail of the aperture of the paratype in figure B; G-K: protoconchs of several paratypes (CHL).

Figura 13. Inella harryleei *spec. nov. A: holotipo, 18,3 mm, fuera de Dry Tortugas, 90 m (CHL); B: paratipo 11,7 mm (BMSM); C: paratipo, 12,8 mm (CHL); D: paratipo, 14,6 mm (FLMNH). E: detalle de la espira del holotipo; F: detalle de la abertura del paratipo de la figura B; G-K: protoconchas de varios paratipos (CHL).*

DALL (1889, pl. 20, fig. 11b) (Fig. 36H), although a little more cylindrical, having only 4 whorls instead 6 and measuring 6.7 mm instead of 10.5, which could be due to the loss of two whorls of the shell. As it is compatible with the description, it was thought that it should be designated as lectotype in order to maintain nomenclatural stability. The other shell examined (Fig. 15B) measured 9.7 mm and had 9 whorls, the label without any indication of "type" and with the name *Triphora bigemma*; it is undoubtedly the same species.

The differences with *I. bigemma* Watson are very small, bearing in mind that although the latter species was described as having only two rows of beads, the figure and the type clearly show three on the final whorls. However, this is a juvenile, and to make a decision it would be necessary to examine the protoconchs and to compare several samples of both species.

The other shell studied (Figs. 15C, 15D) has a profile slightly different from the lectotype, with the whorls expanding more rapidly and with 4-5 spirals on the final whorls. This could represent a different species, but it is rather coincident in some characters with the shell figured by DALL (1889) (Fig. 36H) and for this reason it is considered to be an example of the variability of this taxon, which has differences between the first and the last whorls.

Inella colon (Dall, 1881) (Figs. 16, 36I)

Triforis colon Dall, 1881. *Bull. Mus. Comp. Zool.*, 9: 86. [Type locality: off Havana, Cuba 450 fms (823 m); off Cape San Antonio, 1171 and 1834 m].

Triforis (Inella) colon Dall, 1881. In DALL, 1889. *Bull. Mus. Comp. Zool.*, 18: 249, pl. 20, fig. 12.

Type material: One syntype (Fig. 16A) (f) here designated as lectotype, 12.7 mm, with the label "off Havana, 823 m" (USNM 87315), and another syntype (Fig. 16B) (f) 7.8 mm, now paralectotype, from the same lot. A syntype (Fig. 16C) (f) 8.6 mm, now paralectotype, from Cape San Antonio, 1171-1834 m (MCZ 7387).

Other material examined: 2 f of 16.2 and 5.6 mm, Egmont Key, Florida, Gulf of Mexico, (J. Moore/*Cavalier*, 1968), 180 m (CHL); 1 s (Fig. 16E), Yucatan, 21° 60′ N, 86° 80′ W, ENW of Contoy Light, off Cape Catoche (Riley Black, Apr. 1967) (McGinty coll.) 366-412 m (FLMNH 170221); 1 s (Fig. 16F), 24° 15′ 28″N, 81° 57′ 89″W, Monroe Co., Straits of Florida, 236-255 m (FLMNH 26660).

Type locality: With the designation of the lectotype, the type locality is restricted to off Havana, Cuba 823 m.

Description: See DALL (1881). In the original description the protoconch is mentioned as follows: nucleus and first nuclear whorls white, polished, smooth, flattened on top. The most important characters of the teleoconch are: shell almost cylindrical (Figs. 16A-16C), white, with two main very narrow spiral beaded cords and two smaller, smooth, slightly wavy cords located near the suture; one of them above and the other below the suture, this being almost imperceptible. The nodules are small and slightly prominent; the uppermost a little larger. The axial ribs almost inapparent, a little prosocline; whorls very short and flat.

Dimensions: The lectotype measures 12.7 mm.

Distribution: Known from deep water of Florida, Yucatan and Cuba.

Remarks: The lectotype (Fig. 16A) is in accordance with the original description and it seems to be the shell figured in DALL (1889: pl. 20, fig. 12) (herein Fig. 36I), having the same number of whorls and almost the same dimensions. A paralectotype in the same lot as the lectotype (Fig. 16B) seems to be a different species, because this shell has three spirals instead of two. The paralectotype in MCZ (Fig. 16C) is a little different from the lectotype, but it has the typical distribution of the cords (Fig. 16D) and is probably the same species. Some shells from the Gulf of Mexico (Figs. 16E and 16F) have been included in this taxon but they could rep-

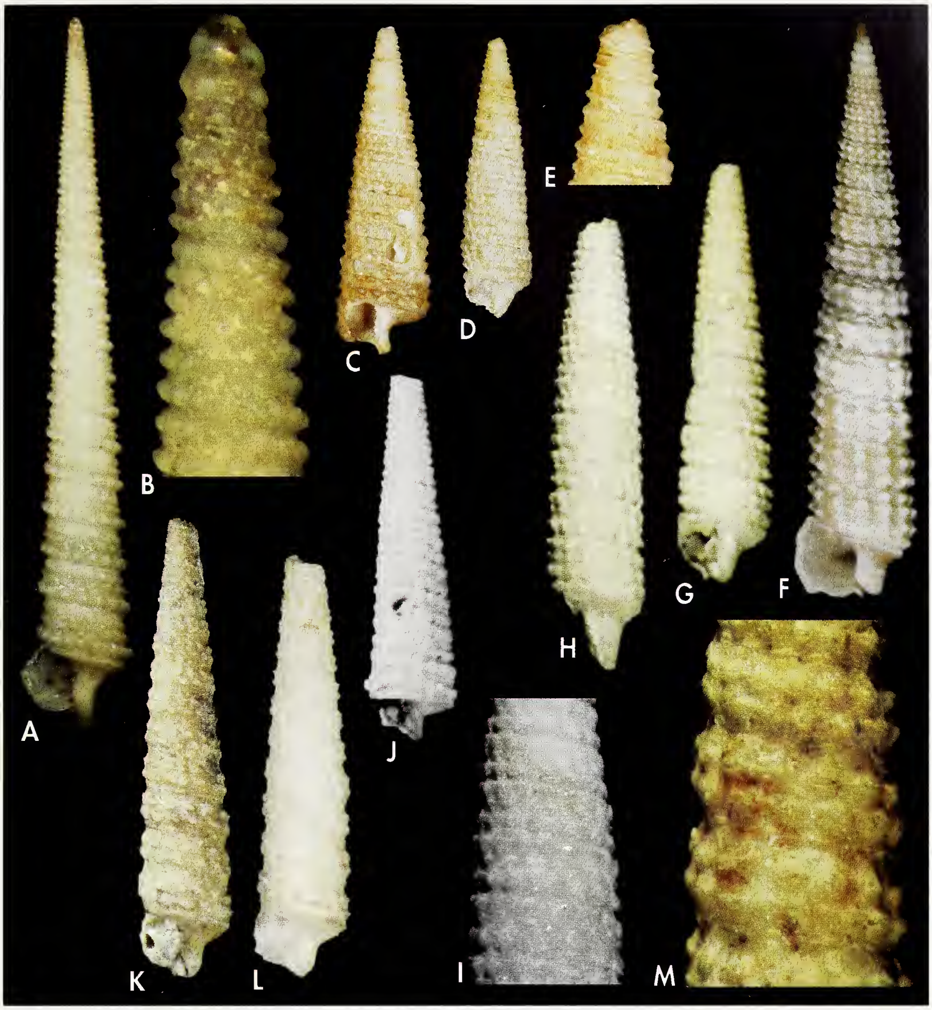

Figure 14. A, B. *Inella* aff. *harryleei*, shell, 28.8 mm and protoconch (FLMNH). C-E. *Inella triserialis* (Dall, 1881). C: lectotype, 6.4 mm (USNM); D: paralectotype, 5.6 mm (USNM); E: protoconch of the paralectotype. F. *Triphora aspera*, lectotype, 13.0 mm (BMNH) (=*Strobiligera brychia*). G-J. *Inella intermedia* (Dall, 1881). G: lectotype, 7.9 mm, off Cuba, Yucatan Strait and Cape San Antonio, 1171 m (syntype of *T. triserialis*, MCZ 7384). H: paralectotype, 7.2 mm, (Havana, off Morro Light, 1473 m (syntype of *T. triserialis*, MZS 7382); I: detail of the sculpture of the paralectotype. J: shell photographed by Kaicher (ANSP, unknown size and other data). K-M. *Inella ibex* (Dall, 1881). K: lectotype, 10.4 mm, off Cuba, Yucatan Strait and Cape San Antonio, 1171 m (MCZ 7391); L: paralectotype, 9.2 mm (USNM 87313); M: detail of the spire of the lectotype.

Figura 14. A, B. Inella *aff.* harryleei, *concha, 28,8 mm y protoconcha (FLMNH). C-E.* Inella triserialis *(Dall, 1881). C: lectotipo, 6,4 mm (USNM); D: paralectotipo, 5,6 mm (USNM); E: protoconcha del paralectotipo. F.* Triphora aspera, *lectotipo, 13,0 mm (BMNH) (*=Strobiligera brychia*). G-J.* Inella intermedia *(Dall, 1881). G: lectotipo, 7,9 mm, fuera de Cuba, Estrecho de Yucatán y Cabo de San Antonio, 1171 m (sintipo de* T. triserialis, *MCZ 7384). H: paralectotipo, 7,2 mm, (La Habana, fuera de Morro Light, 1473 m (sintipo de* T. triserialis, *MZS 7382); I: detalle de la escultura del paralectotipo. J: concha fotografiada por Kaicher (ANSP, tamaño desconocido así como otros datos). K-M.* Inella ibex *(Dall, 1881). K: lectotipo, 10,4 mm, fuera de Cuba, Estrecho de Yucatán y Cabo de San Antonio, 1171 m (MCZ 7391); L: paralectotipo, 9,2 mm (USNM 87313); M: detalle de la espira del lectotipo.*

resent a different species, because the spirals are more prominent and are more widely separated than on the lectotype. However, the lack of protoconch and the differences of the sculpture are not very important, and so provisionally they have been kept in this species awaiting more material in the future.

DALL (1881) referred to the differences between *I. ibex* and *I. colon*, probably because he considered both species very similar. Unfortunately at present their protoconchs are not known, but Dall was of the opinion that the protoconch of *I. ibex* was twice as large as that of *I. colon*. In the teleoconch characters, *I. ibex* has more rapidly expanding whorls, the nodules are larger and are cut at the middle, and fewer whorls occupy the same space.

The other Caribbean species may have two spirals at the beginning of the teleoconch, but finally have three or more spirals. This includes *I. pompona* and *I. meteora*, although spiral 1 is very small and sometimes difficult to see.

Inella unicornium Simone, 2006, from Brazil, has a larger shell (up to 50 mm, the biggest known species of Triphoridae), which according to the original description may be differentiated from *I. colon* not only by its larger size, but also by its proportionally longer whorls, taller spiral cords and projecting outer lip.

Inella undebermuda spec. nov. Rolán and Lee (Figs. 17A-E)

Type material: Holotype (Fig. 17A) in FLMNH; a paratype (Fig. 17B), 12.3 mm, in USNM. Both from type locality (J.R.H. Lightbourn and A.T. Guest, 1988; *ex* J.R.H. Lightbourn 9/8/93; *ex* CHL).
Type locality: S. of Castle Roads, Bermuda, 90 m.
Etymology: The specific name derives from the Latin word *unde* "origin" and the name of the archipelago where the species was collected.

Description: Shell (Figs. 17A, 17B) elongate, whitish and solid. Protoconch (Fig. 17C) white, without a clear separation from the teleoconch, with about two whorls, the nucleus smooth, one spiral cord appearing in the middle of the first whorl and becoming two on the second; the diameter of about 380 µm. The first whorls of the teleoconch have two spiral beaded cords (spirals 1 and 3), and a very small smooth and narrow thread very close to the suture; between the 6-7th whorls, spiral 2, which is also narrow and smooth, appears between the other two, closer to spiral 1. On the subsequent whorls, spiral 2 increases slowly in size, becoming slightly undulating and with nodules appearing at the end of the spire (Fig. 17D), but always remaining nearer to spiral 1. The nodules of spirals 1 and 3 are larger and cut at the middle. Aperture (Fig. 17E) rhomboid, columella almost straight, siphonal canal very short and curved.

Dimensions: The holotype measures 7.8 mm, and the paratype 12.3 mm.

Distribution: Only known from the type locality.

Remarks: The holotype is the smallest shell, but has a protoconch in good condition. The paratype lacks the first protoconch whorl. The most important differential character is the smaller size of spiral 2 and its location closer to spiral 1.

This species must be compared with and separated from the following:

Inella longissima is more elongate and cylindrical and has the three spirals similar in size and distribution. In juveniles assumed to belong to this species, the protoconch has three whorls, and when spiral 2 appears on the first whorls of the teleoconch, it is in the middle between spirals 1 and 3 and not closer to the upper one.

Inella pseudolongissima spec. nov. has a protoconch with four whorls and the spirals of the teleoconch are different, spiral 3 being larger and more prominent than the others. Spiral 2 is only the smaller one at the beginning.

Inella harryleei spec. nov. has three whorls in the protoconch, and in the teleoconch spiral 2 becomes nodulous very early (between whorls 5-6) and is not closer to spiral 1, and the suture is

Figure 15. *Inella torticula* (Dall, 1881). A: lectotype, 6.7 mm (MCZ 7390); B: shell, (labeled as *T. bigemma*), 9.7 mm, 9 whorls, Yucatan Strait, 1171 m (MCZ 7388); C, D: shell, 25.0 mm, Straits of Florida, 1000-1200 m (CHL); E: detail of sculpture. F: shell photographed by Kaicher (ANSP, lacking size and data).

Figura 15. Inella torticula *(Dall, 1881). A: lectotipo, 6,7 mm (MCZ 7390); B: concha, (etiquetada como* T. bigemma*), 9,7 mm, 9 vueltas, Estrecho de Yucatán, 1171 m (MCZ 7388); C, D: concha, 25,0 mm, Estrechos de Florida, 1000-1200 m (CHL); E: detalle de la escultura. F: concha fotografiada por Kaicher (ANSP, careciendo de información sobre su tamaño y otros datos).*

more evident. Furthermore, the colour consists of axial brown flammules and brown siphonal canal, more elongate.

Inella intermedia has a shorter shell and spiral 2 is strongly nodulous on the early whorls, being almost the same size as the other two and located at a similar distance between them.

Inella ibex and *I. colon* have only two main spirals.

Inella torticula can have up to five spirals on the final whorls.

Inella sarissa (Dall, 1889)

Triforis (Inella) sarissa Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 247. [Type locality: near Barbados, 13° 11.54′ N, 59° 38.45′ W, 134 m].

Type material: The lot in USNM labeled as "87314 Holotype" of this species is empty (E. Strong, pers. comm.).

Description: See Dall (1889).The following characters must be pointed out from the original description: three rows of strong tubercles, the uppermost being the largest and spiral 3 the next in size; spiral 2 is the smallest and is close to spiral 1. It is also mentioned that one specimen had 24 whorls, thus being an elongate shell.

Dimensions: 15.5 mm is mentioned in the original description.

Distribution: Only know from its type locality.

Remarks: Apparently only *I. triserialis* has the uppermost spiral with larger nodules, but the other two spirals have the nodules rather similar in size; none of the other species here described have these characters. Anyway *I. triserialis* has a shorter shell.

Inella compsa (Dall, 1927) (Figs. 17F, G)

Triphora (*Strobiligera*) *compsa* Dall, 1927. *Proc. U. S. N. M.*, 70: 96. [Type locality: Off Georgia].

Type material: Lectotype, here designated (Fig. 17F) 12.0 mm, and one paralectotype (Fig. 17G) 9.4 mm (USNM 333518).

Description: See Dall (1927).

Distribution: Only known from the type locality.

Remarks: The description of the species seems to have been based on the characters of both lectotype and paralectotype, in spite of the fact that they may be different species. The lectotype (Fig. 17F) is in accordance with the description with the exception that it has not two but three prominent beaded cords with almost orthocline ribs, but the dimensions are those indicated in the original description. However it is a fragment of a shell with a broken aperture and lacking a protoconch, and it is therefore difficult to define exactly. The paralectotype (Fig. 17G) has only two spirals, with a third appearing on the final whorls close to the undulating thread near the suture, and it could be a different species. Due to the lack of additional material apart from these mentioned types, it is preferable to wait for more suitable material to study in the future.

Inella pseudotorticula spec. nov. Rolán and Lee (Figs. 17H-L)

Type material: Holotype (Fig. 17H) in FLMNH; a paratype (Fig. 17I) in USNM (both *ex* J.R.H. Lightbourn, 9/8/93; *ex* CHL).

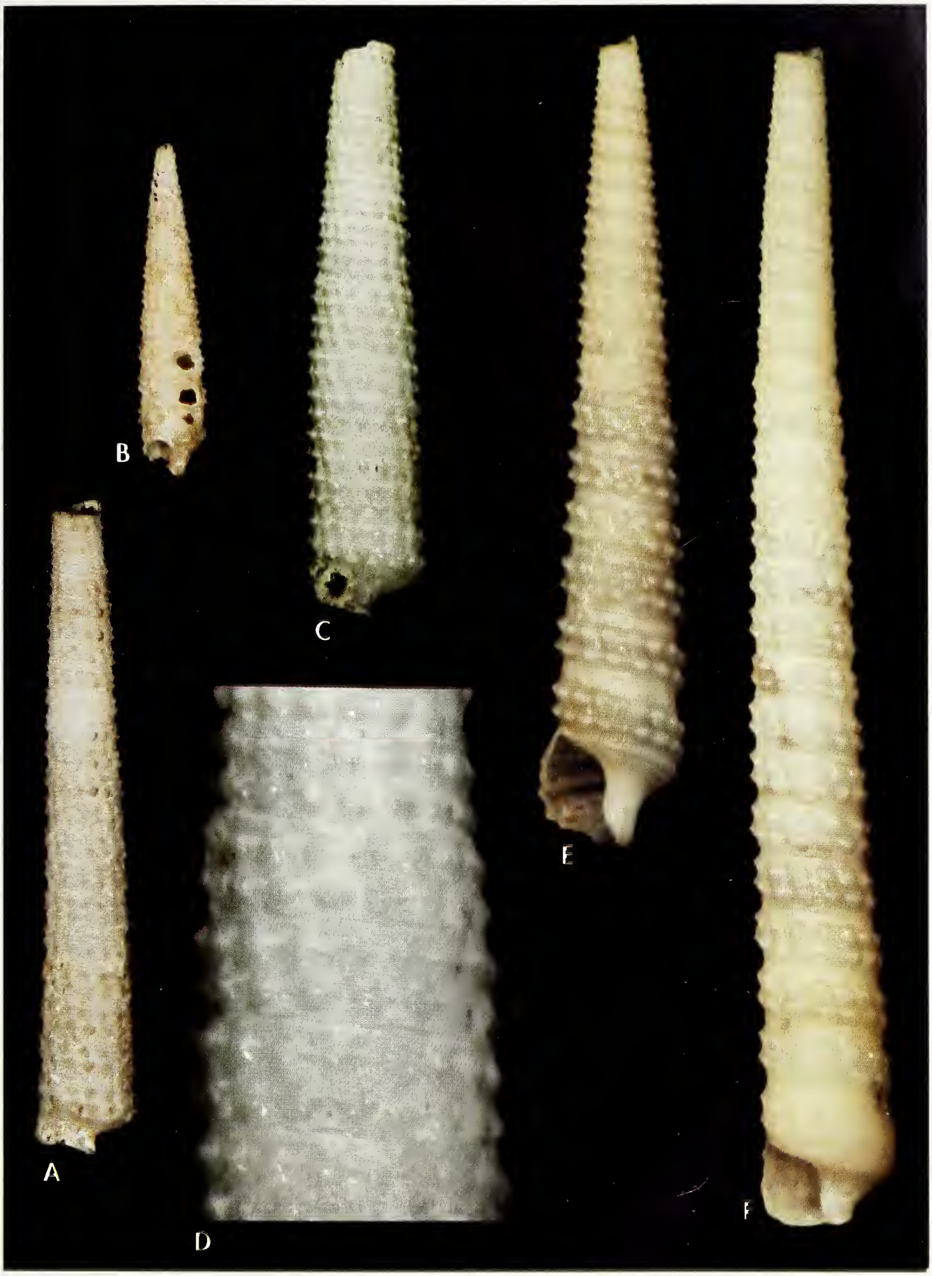

Figure 16. *Inella colon* (Dall, 1881). A: lectotype, 12.7 mm, off Havana, 823 m (USNM); B: paralectotype, 7.8 mm, off Havana, 823 m (USNM); C: paralectotype, 8.6 mm, Cape San Antonio, 1171-1834 m (MCZ 7387); D: detail of the sculpture; E: shell, 20.3 mm, Yucatan (FLMNH); F: shell, 29.4 mm, straits of Florida (FLMNH).

Figura 16. Inella colon *(Dall, 1881). A: lectotipo, 12,7 mm, fuera de La Habana, 823 m (USNM); B: paralectotipo, 7,8 mm, fuera de La Habana, 823 m (USNM); C: paralectotipo, 8,6 mm, Cabo de San Antonio, 1171-1834 m (MCZ 7387); D: detalle de la escultura; E: concha, 20,3 mm, Yucatán (FLMNH); F: concha, 29,4 mm, estrechos de Florida (FLMNH).*

Type locality: South of Castle Roads, SE Bermuda, (J.R.H. Lightbourn and A.T. Guest, 1988) 100 m.
Etymology: The specific name alludes to the similarity with *I. torticula*.

Description: Shell (Figs. 17H, 17I) very elongate, pointed, with blunt apex, not straight in profile, solid. Protoconch (Fig. 17J) with about 2 1/2 whorls, with a wide nucleus and two spiral cords, of which the upper one is smaller and less prominent; diameter of about 400 µm. The teleoconch has about 23 whorls (on the holotype) with spirals 2 and 3 present from the beginning, very similar in size, and with the nodules cut in the middle. On the early whorls spiral 1 is very small and is located close to the upper suture, with spiral 4 appearing like a fine thread near the lower suture; on about the ninth whorl, spiral 1 is more clearly defined on the upper part of the whorl, below the suture, but is smaller and less prominent than the other two, while spiral 2 is the most prominent and slightly larger; on about the seventeenth whorl, spiral 1 continues to be closer to spiral 2 (Fig. 17K). On about the twenty-first whorl, the three spirals are almost similar in size. Aperture (Fig. 17L) ovoid with a short siphonal canal.

The shell has some white whorls alternating with entirely light brown whorls. The cords are often light brown between the nodules.

Dimensions: The holotype measures 16.8 mm.

Distribution: Only know from the type locality.

Remarks: This species must be compared with the following ones that have elongate shells:

Inella longissima has spirals 1 and 3 from the beginning, with spiral 2 appearing below; at the end of the spire the spirals are of almost equal strength, but spiral 2 is slightly smaller and spiral 3 a little more prominent on most of the shell.

I. pseudolongissima spec. nov. has spirals 1 and 3 from the beginning, with spiral 2 smaller; on the final whorls spiral 3 is noticeably larger than the others; the colour is whitish. The protoconch has four whorls.

I. harryleei spec. nov. has spirals 1 and 3 from the beginning; spiral 2 appears after the first few whorls but remains smaller throughout the shell; at the end, spiral 3 is very large in comparison with the others; the colour is white or light brown with brown axial flammules.

I. triserialis (Dall, 1881) has a shorter shell with three spirals, spiral 1 being larger with more inflated nodules. The apex is more depressed.

I. intermedia (Dall, 1881) has a shorter shell with spirals 1 and 3 present at the beginning; spiral 2 is smaller and appears later.

I. ibex (Dall, 1881) and *I. colon* have only two prominent beaded cords.

I. torticula (Dall, 1881) has spiral 1 less prominent on the early whorls; subsequently the final whorls are wider and have up to 5 spirals.

I. undebermuda spec. nov. has spirals 1 and 3 at the beginning of the teleoconch, with spiral 2 appearing between the other two, always remaining smaller and closer to spiral 1.

I. unicornium, described by Simone, 2006 from Brazil, has some general similarity with *I. pseudotorticula*, but the holotype is a shell with 40 whorls that measures almost 50 mm in height; also it is mentioned in the original description that the protoconch has only one whorl and the teleoconch whorls have only two beaded spiral cords, with an additional smooth cord appearing on the final whorl.

Inella enopla (Dall, 1927) (Figs. 18A-E)

Triphora enopla Dall, 1927. *Proc. U. S. N. M.*, 70: 95. [Type locality: Off Fernandina, Florida, 294 fms (538 m)].

Figure 17. A-E. *Inella undebermuda* spec. nov. A: holotype, 7.8 mm, S. of Castle Roads, Bermuda, 90 m (FLMNH); B: paratype, 12.3 mm, same locality (USNM); C: protoconch of the holotype; D: detail of the sculpture, holotype; E: detail of the aperture, holotype. F, G. *Inella compsa* (Dall, 1927). F: lectotype, 12.0 mm, off Georgia, 805 m; (USNM); G: paralectotype, 9.4 mm, off Georgia, 805 m (USNM). H-L. *Inella pseudotorticula* spec. nov. H: holotype, 16.8 mm, SE Bermuda (FLMNH); I: paratype, 8.5 mm, S. of Castle Roads, Bermuda (USNM); J: protoconch, holotype; K: detail of the sculpture, holotype; L: detail of the aperture.

Figura 17. A-E. Inella undebermuda *spec. nov. A: holotipo, 7,8 mm, S. de Castle Roads, Bermuda, 90 m (FLMNH); B: paratipo, 12,3 mm, la misma localidad (USNM); C: protoconcha del holotipo; D: detalle de la escultura, holotipo; E: detalle de la abertura, holotipo. F, G.* Inella compsa *(Dall, 1927). F: lectotipo, 12,0 mm, fuera de Georgia, 805 m; (USNM); G: paralectotipo, 9,4 mm, fuera de Georgia, 805 m (USNM). H-L.* Inella pseudotorticula *spec. nov. H: holotipo, 16,8 mm, SE Bermuda (FLMNH); I: paratipo, 8,5 mm, S. de Castle Roads, Bermuda (USNM); J: protoconcha, holotipo; K: detalle de la escultura, holotipo; L: detalle de la abertura.*

Type material: Lectotype (2 f, labeled as "type"), here designated (Figs. 18A, 18B) and 5 paralectotypes (3 j, 2 f) (USNM 108074).
Other material examined: 2 f (with the label "*Triforis colon*"), off Havana, Cuba 823 m (Blake Expedition, Sta. 243) (BMNH acc. nº 2283).

Description: DALL (1927). Protoconch (Figs. 18C, 18D) with the apex smooth, pupoid, wide (about 500 µm), followed by about 2 whorls with three very close cords, the uppermost smaller and the lowest one the largest and most prominent. Teleoconch whorls with two spiral nodulous cords and another two very fine cords that are separated by the suture (Fig. 18E); the subsutural one is very small and has elongate nodules, while the one just above the suture is smooth. The nodules on the main spirals are pointed and cut at the middle.

Dimensions: The lectotype consists of fragments measuring 7.2 and 6.6 mm.

Distribution: Only known from Florida and Cuba.

Remarks: The original description mentions 15 whorls and dimensions of 11.5 x 2 mm. The glass tube labeled "type" contained two fragments (7.2 and 6.6 mm respectively), but there were no apparent indication thar they were previously unitedtherefore it is doubtful, although possible, that they came from the same shell. However, they give a good representation of the specific characters, and as it is not certain whether or not they are from the same broken shell, it is better to keep both fragments together and consider both as parts of the lectotype.

The large pupoid protoconch is the most important differential character. The most similar species are:

I. inflata has the protoconch whorls with two scarcely visible spiral cords, the nodules of the teleoconch smaller and sharply pointed, the shell with rapidly enlarging whorls.

Inella bigemma has the shell with more rapidly enlarging whorls, spiral 1 more developed and more clearly nodulous.

I. ibex is not so cylindrical and has more pointed nodules, with only one small thread near the suture, lacking the small upper spiral on the final whorls.

I. harryleei, I. compsa, I. pseudotorticula spec. nov. and *I. intermedia* have three spiral cords.

I. colon has a more cylindrical shell, with spiral cords less prominent, the nodules very small, and the small cords at both sides of the suture almost imperceptible.

I. undebermuda has three main spirals, spiral 2 being small and close to spiral 1; only one small thread near the suture.

I. pompona has a much larger space between spiral 2 and spiral 3, the nodules are smaller and the protoconch is wider and more prominent at the apex, and has two spiral cords.

Inella meteora (Dall, 1927) (Figs. 18F-H)

"Triphora" meteora Dall, 1927. *Proc. U. S. N. M.*, 70: 95. [Type locality: Off Fernandina, Florida].

Type material: Lectotype (labeled as "type", in three fragments), here designated (Figs. 18F, 18G) (USNM 108081) and 3 paralectotypes.

Description: DALL (1927). The protoconch (Fig. 18G) is pupoid with about 2 whorls and a diameter of about 600 µm; below the nucleus there are two main smooth spiral cords and another smaller subsutural one.

The whorls of the teleoconch have three spiral cords from the beginning (Fig. 18H), the lower two more similar in prominence, the nodules slightly larger on spiral 2; the uppermost is smaller from the beginning of the teleoconch and also is less prominent on the final whorls. The nodules are uniformly rounded on spiral 1 and larger and cut at the middle on the other two. Above

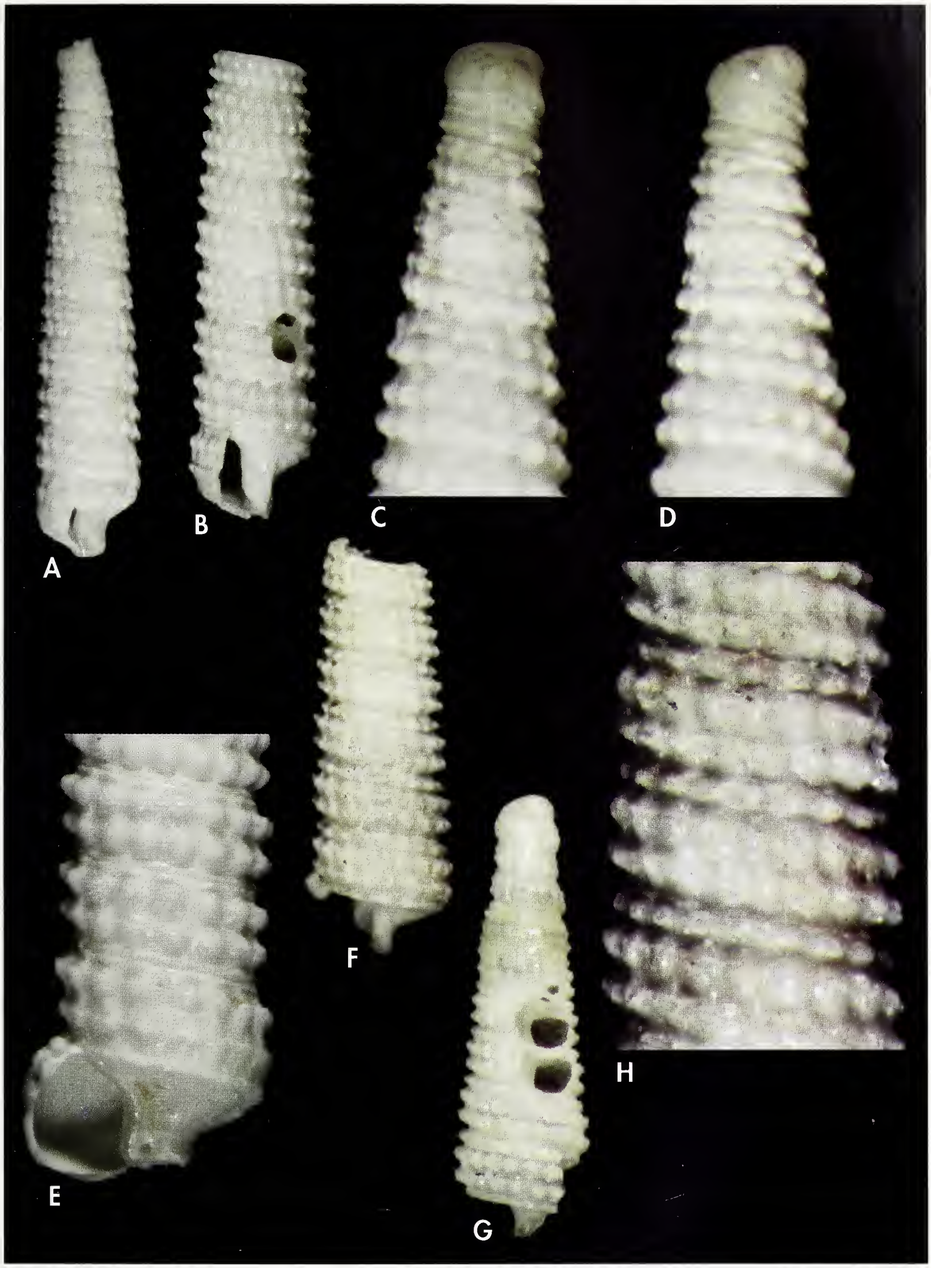

Figure 18. A-E. *Inella enopla* (Dall, 1927). A, B: two fragments labeled as "type", 7.2, 6.6 mm, 538 m (USNM); C, D: protoconch of a paralectotype; E: detail of the sculpture of a paralectotype. F-H. *Inella meteora* (Dall, 1927). F, G: two fragments labeled as "type" 4.0 and 5.1 mm, off Fernandina, 538 m (USNM); H: detail of the sculpture.

Figura 18. A-E. Inella enopla *(Dall, 1927). A, B: dos fragmentos etiquetados como "tipo", 7,2, 6,6 mm, 538 m (USNM); C, D: protoconcha de un paralectotipo; E: detalle de la escultura de un paralectotipo. F-H.* Inella meteora *(Dall, 1927). F, G: dos fragmentos etiquetados como "tipo" 4,0 y 5,1 mm, fuera de Fernandina, 538 m (USNM); H: detalle de la escultura.*

the suture there is a small undulating thread.

Dimensions: See below.

Distribution: Only know from its type locality.

Remarks: The original description gives dimensions of 9 x 2 mm; the fragments in the tube labeled "type" measure 6.2, 5.1 and 4.0 mm; they are of the same species but probably not from the same shell.

The 3 paralectotypes in the other tube appear to be a different species.

The differences with the closest species are:

I. bigemma has two spirals at the beginning of the teleoconch.

I. pompona and *I. inflata* have two spirals at the beginning of the teleoconch and a wider, pupoid protoconch.

I. longissima has two spirals at the beginning, subsequently three regular spirals of similar size, with spherical nodules, and the protoconch has three whorls.

I. pseudolongissima spec. nov. has a protoconch with 4 whorls, and spirals 2 and 3 are more evident at the beginning of the teleoconch.

I. harryleei has a more depressed apex on the protoconch; on the teleoconch the lower spiral is larger, with spiral 2 smaller.

I. ibex and *I. enopla* have only two spirals on the protoconch.

I. torticula can have up to 5 spirals at the end.

I. colon is more cylindrical and has only two main spirals on the teleoconch with small nodules.

I. undebermuda spec. nov. has two main spirals at the beginning of the teleoconch and one smaller spiral 2 in-between, located closer to spiral 1.

I. compsa is more conical, having more rapidly enlarging whorls; the nodules are less prominent and spherical.

I. pseudotorticula spec. nov. has a protoconch with a smaller diameter and with 2 well defined cords; only spirals 2 and 3 are present at the beginning of the teleoconch, spiral 1 appearing later.

Inella pompona (Dall, 1927) (Figs. 19A-C)

Triphora (Strobiligera) pompona Dall, 1927. *Proc. U. S. N. M.*, 70: 94. [Type locality: Off Georgia].

Type material: In the material under this name from USNM (Figs. 19A-19C) there is a label mentioning "type", but in the three glass tubes there is no other indication. The shell measuring almost 20 mm with 21 whorls is here designated as lectotype (Fig. 19A); it is referred to in the original description as the "larger but imperfect specimen" because the apex is missing. Numerous paralectotypes (USNM 108339), most of them fragments (6 in one tube and 48 in another); the largest fragment measures 23.5 mm.

Description: Dall (1927). The protoconch (Fig. 19B) is pupoid and wide, the nucleus and the first whorl wider than the subsequent ones, with the diameter of the first whorl between 650 and 750 µm; in the original description it is described as having 1 $^{1}/_{2}$ whorls, but it can have more than 2 whorls, the second one with two spiral cords. Teleoconch with two main spirals (spirals 2 and 3); spirals 1 and 4 are very close to the suture, which separates them (Fig. 19C). Spiral 1 has very small nodules, while spiral 4 is smooth. The nodules on the main spirals are not very prominent and only a little higher than the cords, and they are slightly cut at the middle.

Dimensions: The lectotype measures almost 20 mm, and some shells are somewhat larger.

Distribution: Only know from the type locality.

Remarks: The species with a pupoid and wide protoconch are:

I. enopla has a slightly narrower protoconch of three whorls, with three scarcely visible spiral cords.

I. ibex and *I. colon* each have information on the protoconch in the original description, but shells with a complete

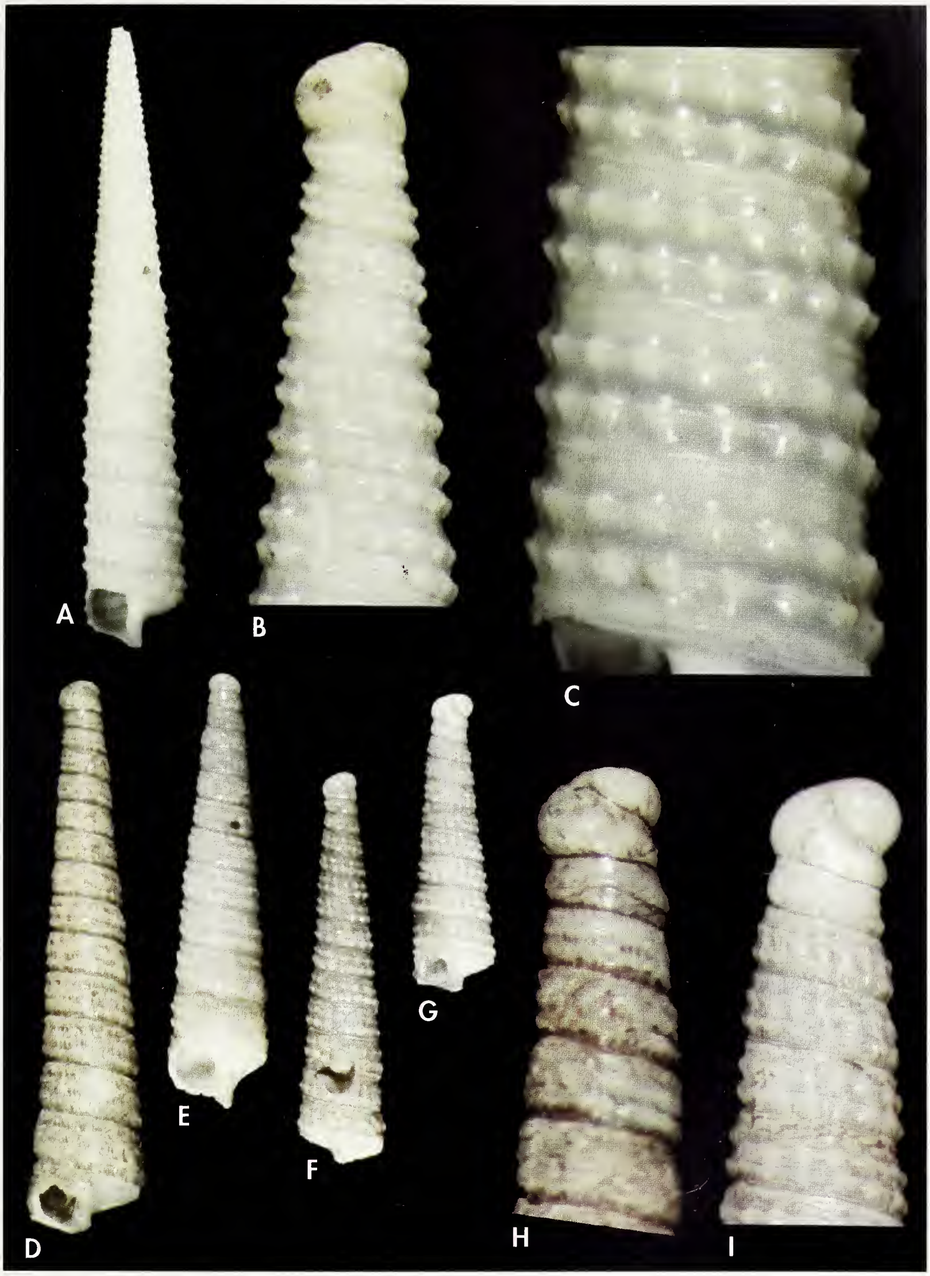

Figure 19. A-C. *Inella pompona* (Dall, 1927). A: lectotype, 19.5 mm, 804 m (USNM); B: protoconch of a paralectotype; C: detail of the sculpture of lectotype. D-I. *Inella dinea* (Dall, 1927). D: lectotype, 7.9 mm, 804 m (USNM); E-G: paralectotypes, 6.6, 6.0. 4.7 mm, same locality; H, I: protoconchs, lectotype and paralectotype.

Figura 19. A-C. Inella pompona *(Dall, 1927). A: lectotipo, 19,5 mm, 804 m (USNM); B: protoconcha de un paralectotipo; C: detalle de la escultura del lectotipo. D-I.* Inella dinea *(Dall, 1927). D: lectotipo, 7,9 mm, 804 m (USNM); E-G: paralectotipos, 6,6, 6,0, 4,7 mm, la misma localidad; H, I: protoconchas, lectotipo y paralectotipo.*

apex are not known; on the teleoconch there are similarly two spiral beaded cords, but on *I. colon* the sutural area is narrower and the nodules are smaller; *I. ibex* has smooth spirals at the beginning of the teleoconch.

I. inflata has a similar protoconch, but clearly narrower; there is a greater increase in the width of the whorls and the suture is more prominent.

I. undebermuda spec. nov. has a narrower protoconch; in the teleoconch, between the main spirals 1 and 3, there is a small spiral 2 closer to spiral 1.

I. dinea (see below).

The species with unknown protoconch:

I. compsa has rapidly enlarging whorls and three almost similar spirals.

I. sarissa has spiral 1 larger, with spiral 2 very small and close to spiral 1.

I. bigemma has small nodules on spiral 1 and fewer whorls, never elongated.

Inella dinea (Dall, 1927) (Figs. 19D-I)

"Triphora" pompona dinea Dall, 1927. *Proc. U. S. N. M.*, 70: 94. [Type locality: Off Georgia, 440 fms (805 m)].

Type material: Lectotype (Fig. 19D), here designated, and 11 paralectotypes (Figs. 19E-19G) (USNM 333517).

Description: DALL (1927), comparing shells to typical *I. pompona*, only mentioned that the beading is less prominent and the shells are more slender and compact, measuring 10 mm for 15 whorls, with a maximum diameter of 1.75 mm. Now it can be added that the protoconch (Figs. 19H, 19I) has between $2\,^1/_4$ - $2\,^1/_2$ smooth whorls and is a little variable in size, but it can reach up to 700 µm and is pupoid at the apex, with a large nucleus and with two or three depressed smooth cords on the second whorl. On the teleoconch, the suture has a smooth fine cord on each side. The axial sculpture is formed by small ribs on some shells; on others the ribs are almost absent; there are small orthocline growth lines. There are three spirals, equal in size on the lectotype but with spiral 1 less prominent on other shells.

Dimensions: The lectotype measures 7.9 mm.

Distribution: ROSENBERG (2005) gives coordinates of 30.73° N, 79.43° W, with a depth of 805 m.

Remarks: In the material studied there was no shell measuring 10 mm, but the designated lectotype has 14 whorls including the protoconch, and is almost 8 mm. This shell was chosen because the number of whorls is closest to the number given in the description. Also because it has three similar cords on each whorl, very different from *T. pompona*. Not all the paralectotypes seem to be the same species.

Although the present taxon was published as a variety of *T. pompona*, comparison of the types of both species allowed us to confirm that they are different species. *T. pompona* has two nodulous cords per whorl and a very small cord, lacking nodules, on either side of the suture. *T. dinea* has a similar pupoid protoconch but the shell is variable, with some shells having three cords of similar size; other shells have only two spiral nodulous cords and the third, near the suture, is depressed. These could represent characters of two different species but, as the studied material did not include enough complete shells, it is better to keep these two morphs within *T. dinea*.

I. sentoma has a flat profile, lacks nodules and is also a larger shell.

I. gaesona has depressed spirals almost without nodules and the protoconch is narrower, with a depressed apex.

I. inflata has a narrower protoconch, with 2 poorly defined cords. The teleoconch has more prominent spirals and nodules.

Figure 20. A, B. *Inella sentoma* (Dall, 1927). A: lectotype, 28 mm, off Fernandina, 538 m (USNM): B: paralectotype, 4.4 mm, same locality (USNM). C. *Inella gaesona* (Dall, 1927), lectotype, 9 mm, off Georgia, 805 m (USNM). D-H. *Inella differens* spec. nov. D: holotype, 7.6 mm, off Egmont Key, Hillsborough Co., Florida (FLMNH); E: paratype, 6.2 mm; F, G: protoconchs of holotype and paratype; H; detail of the sculpture.

Figura 20. A, B. Inella sentoma *(Dall, 1927). A: lectotipo, 28 mm, fuera de Fernandina, 538 m (USNM): B: paralectotipo, 4,4 mm, la misma localidad (USNM). C.* Inella gaesona *(Dall, 1927), lectotipo, 9 mm, fuera de Georgia, 805 m (USNM). D-H.* Inella differens *spec. nov. D: holotipo, 7,6 mm, fuera de Egmont Key, Hillsborough Co., Florida (FLMNH); E: paratipo, 6,2 mm; F, G: protoconchas del holotipo y paratipo; H; detalle de la escultura.*

Inella sentoma (Dall, 1927) (Figs. 20A-B)

Triphora sentoma Dall, 1927. *Proc. U. S. N. M.*, 70: 96. [Type locality: Off Fernandina, Florida, 805 m].

Type material: Lectotype, here designated (Fig. 20A), 28 mm and a paralectotype (Fig. 20B), 4.4 mm (USNM 108072).

Description: See DALL (1927). The protoconch is unknown. Both the lectotype and paralectotype are in very poor condition, so the most important characters from the original description are mentioned here: two low flattened spiral cords, faintly undulated, one at the periphery of the whorl, the other in front of it; the suture linear with a minute threadlet on each side of it, the interspaces shallow.

In reality it can be said that there are grooves and orthocline growth lines, but no prominent sculpture.

Dimensions: The lectotype measures 28 mm.

Distribution: Only know from its type locality.

Remarks: This species is very elongate and with depressed sculpture. There is no information about the protoconch or aperture, but in the original description it is mentioned that one of the fragments had a protoconch of a whorl and a half. For this reason and the almost cylindrical shell form it is included in the genus *Inella*.

The paralectotype (Fig. 20B) is more similar to the lectotype of *I. gaesona* (see below).

No other *Inella* species in the studied area has such depressed sculpture.

Inella gaesona (Dall, 1927) (Figs. 20C)

Triphora (Strobiligera) gaesona Dall, 1927. *Proc. U. S. N. M.*, 70: 95. [Type locality: Off Georgia, 805 m].

Type material: Lectotype, here designated (Fig. 20C) with 16 whorls, 9 mm (USNM 1088341). Paralectotypes: 15 s and f (not examined) (USNM).

Description: See DALL (1927). Protoconch paucispiral, pupoid and depressed, with the first whorl wider than the following one. The spiral sculpture is formed more by grooves which separate the whorls into three parts than by prominent spirals. The axial sculpture consists only of orthocline growth lines.

Dimensions: The lectotype measures 9 mm.

Distribution: Only know from its type locality.

Remarks: Species very different from any other due to the pupoid and depressed protoconch and the flat spiral cords without nodules. It only has some similarity to *I. sentoma*, but a complete comparison could not be made because of the poor condition of the lectotype of this species and the lack of sufficient material. For this reason they are kept as different valid taxa, awaiting more material for study.

Inella differens spec. nov. Rolán and Lee (Figs. 20D-H)

Type material: Holotype (Fig. 20D) in FLMNH. Paratype (Fig. 20E) in BMSM (both *ex* CHL).
Other material examined: Off Louisiana: 3 f without protoconch, 28° 05.61′ N, 91° 02.245′ W by 28° 05.524′ N, 91° 02.036′ W, 58 m (E. F. Garcia/*Pelican* 06/09/00) (CHL).
Type locality: Off Egmont Key, Hillsborough Co., Florida, USA, (J. Moore/*Cavalier*, 1962), 135 m.
Etymology: The specific name alludes to the shell having different characters from others in the area.

Description: Shell subcylindrical (Figs. 20D, 20E) solid, light brown. Protoconch (Figs. 20F, 20G) pupoid with 1 3/4 -2 whorls and a diameter of about

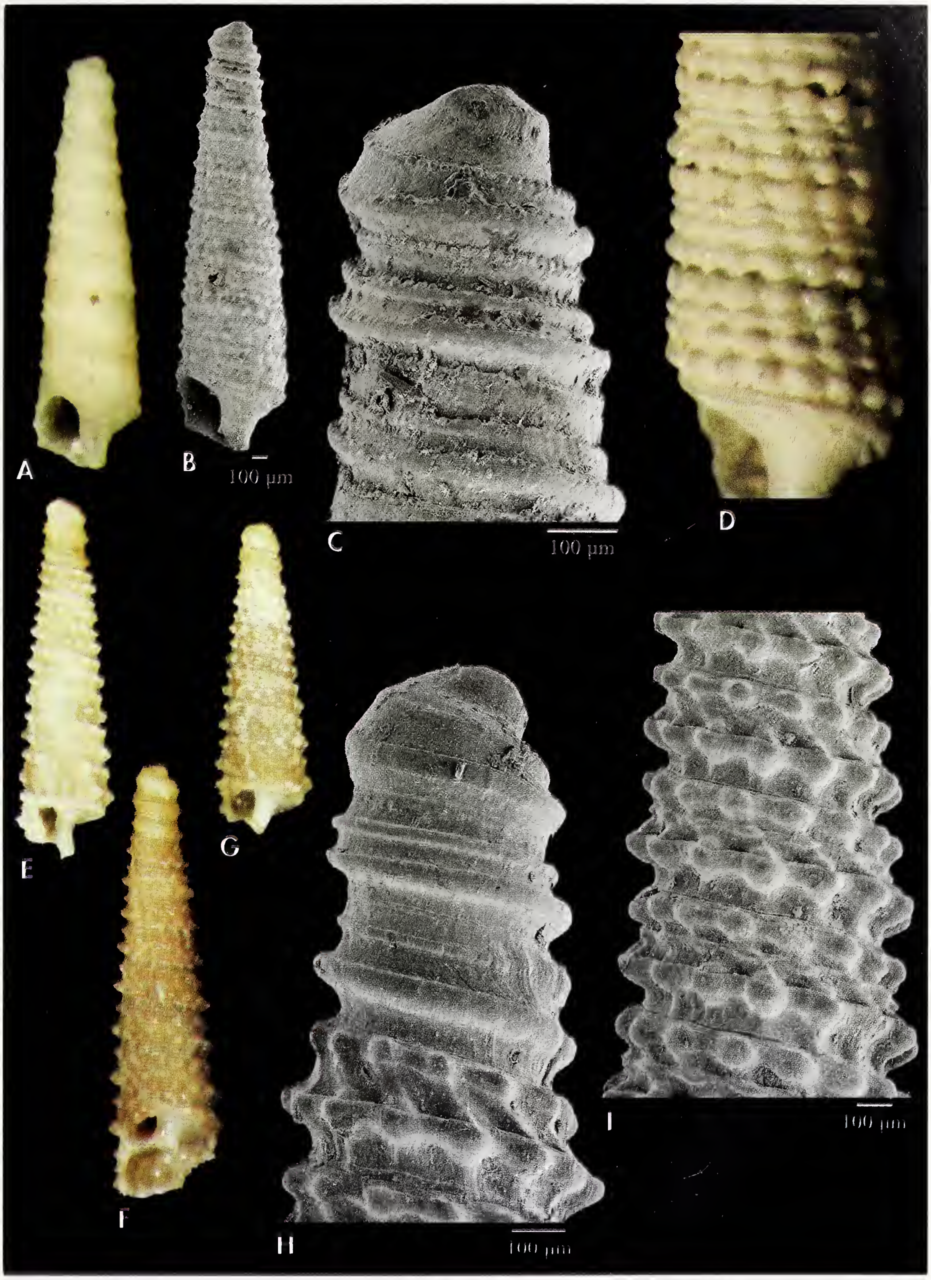

Figure 21. A-D. *Inella slapcinskyi* spec. nov. A, B: holotype, 2.6 mm (FLMNH); C: protoconch of the holotype; D: detail of the fragment (ANSP). E-I. 1: *Inella faberi* spec. nov. E: holotype, 3.7 mm; F, G: paratypes, 4.4 and 3.0 mm. Louisiana (FLMNH); H, I: protoconch and detail of teleoconch sculpture, paratype in figure F.

Figura 21. A-D. Inella slapcinskyi *spec. nov. A, B: holotipo, 2,6 mm (FLMNH); C: protoconcha del holotipo; D: detalle del fragmento (ANSP). E-I. 1:* Inella faberi *spec. nov. E: holotipo, 3.7 mm; F, G: paratipos, 4.4 y 3.0 mm. Louisiana (FLMNH); H, I: protoconcha y detalle de la escultura de la teloconcha, paratipo de la figura F.*

600 μm, the nucleus smooth and the whorls with two smooth spiral cords. The teleoconch begins when the two spiral cords become nodulous; these beaded spirals are equal in size and both are closer to the suture and more widely separated in the middle of the whorl. About the fourth or fifth whorl, spiral 2 appears below and very close to spiral 1, beginning as a fine thread undulating beneath the nodules (Fig. 20H). Immediately it becomes nodulous but with a smaller nodular size. About the eleventh whorl the nodules reach almost the size of those on spirals 1 and 3. There are three additional smooth cords on the base. Aperture ovoid elongate; siphonal canal short and open.

Dimensions: The holotype measures 7.6 mm.

Distribution: Only know from its type locality.

Remarks: This species is kept in the genus *Inella* due to the characteristic protoconch.

It may be differentiated from most of the other closely similar species by its short protoconch with only 1 $^3/_4$ - 2 whorls and its brown colour:

I. dinea has more weakly sculptured whorls and the protoconch has a wider pupoid form.

I. meteora, *I. undebermuda* spec. nov., *I. enopla* and *I. pompona* have a similar number of protoconch whorls but the apex is more inflated and pupoid, and the shells are larger and white; furthermore, *I. meteora* has three spiral cords on the teleoconch, spiral 1 being smaller; *I. undebermuda* has spiral 2 beginning on about the tenth whorl (instead of on the fourth in *I. differens*), and it is very small and closer to spiral 1; *I. enopla* and *I. pompona* have two main spiral cords on the teleoconch with an additional cord on each side of the suture, the protoconch being very much wider.

I. triserialis has a rather similar shell but the protoconch has 3 whorls, the apex is more depressed, the nodules of spiral 1 are larger and cut at the middle.

I. sarissa is white, spiral 2 is smaller and very close to spiral 1.

I. compsa has rapidly enlarging whorls, and spiral 2 is not smaller.

I. intermedia has a larger shell that is lighter, whitish and more conical, the spirals almost equal in size.

See also *I. faberi* below.

Inella slapcinskyi spec. nov. Rolán and Fernández-Garcés (Figs. 21A-D)

Type material: Holotype (juvenile, Figs. 21A, 21B) (FLMNH UF350382).
Other material studied: 1 f (ANSP).
Type locality: Cayman Islands, Little Cayman, Jackson's Bight (P. Watson, Dec/1992), 35 m.
Etymology: The species is named after John Slapcinsky, Curator of Molluscs of the FLMNH, for his help in the examination of the material housed in this museum.

Description: Shell (Figs. 21A, 21B) small, almost cylindrical, whitish. Protoconch paucispiral (Fig. 21C) with a diameter of about 400 μm and almost three whorls, with two narrow spiral cords on the first whorl, three on the following, well defined, the lower one more prominent; each spiral cord bears a row of small tubercles on its upper surface. The nucleus of the protoconch is very small. The teleoconch has four spirals; spiral 1 has more prominent nodules; spiral 4 is the next in size and spirals 2 and 3 have smaller, elongated nodules (Fig. 21D). The axial ribs are wide and strongly prosocline. On the base there are two more smooth spirals. Aperture rounded with a strong columellar callus; siphonal canal short and open.

Dimensions: The holotype measures 2.6 mm.

Distribution: Only known from its type locality.

Remarks: This species has been named in spite of the scarcity of available material because the shell and the protoconch have characters that are absolutely different from any other species of this group in the study

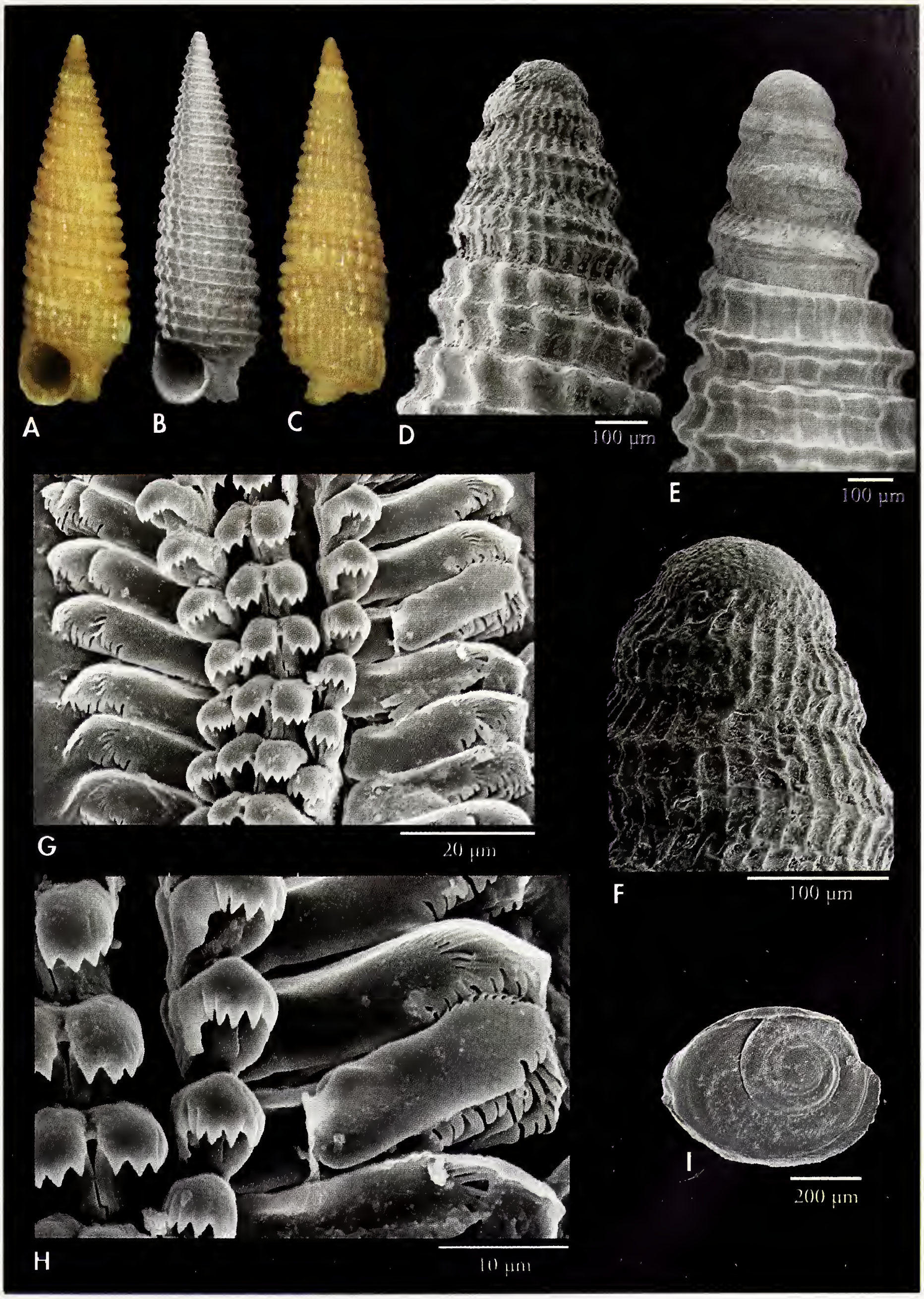

Figure 22. *Sagenotriphora osclausum* (Rolán and Fernández-Garcés, 1995). A-C: shells, 4.9, 4.9 and 4.8 mm, E Palm Beach, Florida (CHL); D-F: protoconchs; G-H: radula, specimen from off Palm Beach, Florida (CHL); I: operculum.

Figura 22. Sagenotriphora osclausum *(Rolán y Fernández-Garcés, 1995). A-C: conchas, 4,9, 4,9 y 4,8 mm, E Palm Beach, Florida (CHL); D-F: protoconchas; G-H: rádula, de un ejemplar de fuera de Palm Beach, Florida (CHL); I: opérculo.*

area. Only *I. torticula* has 4 beaded spirals, and no species in the study area has a row of tubercles on the protoconch.

Inella faberi spec. nov. Rolán and Fernández-Garcés (Figs. 21E-I)

Type material: Holotype (Fig. 21E) and 2 paratypes (Figs. 21F, 21G) in FLMNH (UF 291343).
Type locality: Louisiana, 28.05731° N, 92.44963° W, 71-74 m.
Etymology: The species is named after the Dutch malacologist Marien Faber, who studied many of the species of Caribbean Triphoridae and helped us in some aspects of this work.

Description: Shell (Figs. 21E-21G) subcylindrical, solid, brownish in colour. Protoconch (Fig. 21H) with almost three whorls which have two narrow well defined spirals, the lower of which is a little more prominent; its diameter is about 450 µm. The teleoconch begins with two nodulous spirals 1 and 3, quite close together; spiral 1 is slightly smaller and less prominent than spiral 3. Subsequently spiral 2 appears between them and remains smaller (Fig. 21I). The axial ribs which connect the nodules are strongly prosocline. The nodules are different on the three spirals: on spiral 1 they are spherical and a little ovoid, on spiral 2 they are very elongate and narrow, and on spiral 3 the nodules are larger and cut by the spiral which crosses them. Aperture rounded but in poor condition on all the type material.

Dimensions: The holotype measures 3.7 mm. One paratype reaches 4.4 mm.

Distribution: Only known from the type locality.

Remarks: The most similar species are:

I. differens spec. nov. has a wider protoconch, apically more depressed and with only 2 whorls, the nodules of the teleoconch are all spherical and the axial ribs almost orthocline.

I. undebermuda spec. nov. has a protoconch with only 2 whorls, the nucleus more elevated; spiral 2 on the teleoconch is closer to spiral 1 and the axial ribs are slightly prosocline.

I. apexbilirata spec. nov. has cords of similar size on the protoconch, the shell is whitish, and on the teleoconch spiral 1 has very small nodules, spirals 2 and 3 have larger nodules which are cut at the middle, and the axial ribs are almost orthocline.

I. harryleei spec. nov. has a very elongate shell, a protoconch with cords of similar size, and the teleoconch has spiral 3 with much larger and more prominent nodules.

Genus *Sagenotriphora* Marshall, 1983

Type species (by original designation): *Triphora ampulla* Hedley, 1903. Recent, southern Australia and northern New Zealand.

Description: Protoconch multispiral with reticulate sculpture on the first whorl; radula with a rachidian tooth which is separated into two parts, and only one lateral and one marginal.

Sagenotriphora osclausum (Rolán and Fernández-Garcés, 1995) (Figs. 22A-I)

"Triphora" osclausum Rolán and Fernández-Garcés, 1995. *Apex*, 10(1): 21.

Type material: Holotype and paratypes (see ROLÁN AND FERNÁNDEZ-GARCÉS, 1995)
Other material examined: Florida: 3 s, beach drift, Little Torch Key, Monroe Co., (M. Teskey, 5/76) (CHL); 2 sp, 32 miles E St. Augustine, St. Johns Co. (T. Yocius 6/81; *ex* J. Dawley 12/2/90), 30 m

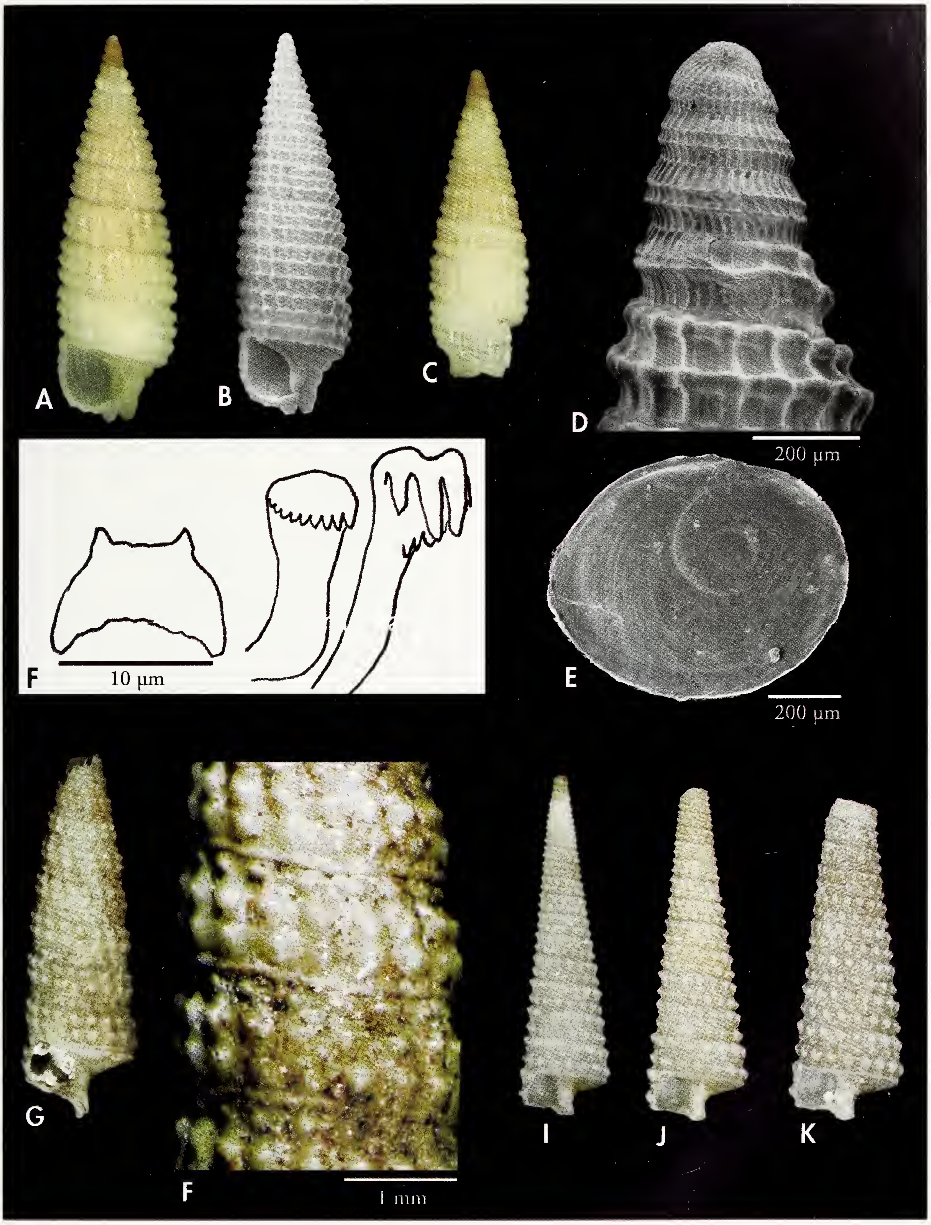

Figure 23. A-F. *Sagenotriphora candidula* spec. nov. A, B: holotype, 5.0 mm (FLMNH); C: paratype 3.9 mm, from type locality (BMSM); D: protoconch of the holotype; E: operculum; F: drawing of the radula. G, H. *"Triphora" abrupta* (Dall, 1881); G: lectotype, 7.9 mm (MCZ 7389); H: Detail of the spire. I-K. *"Triphora" caracca* Dall, 1927. I: lectotype, 7.1 mm, off Georgia, 805 m (USNM): J, K: paralectotypes, 6.9, 6.7 mm, same locality (USNM).

Figura 23. A-F. Sagenotriphora candidula *spec. nov. A, B: holotipo, 5,0 mm (FLMNH); C: paratipo 3,9 mm, de la localidad tipo (BMSM); D: protoconcha del holotipo; E: opérculo; F: dibujo de la rádula. G, H.* "Triphora" abrupta *(Dall, 1881); G: lectotipo, 7,9 mm (MCZ 7389); H: Detalle de la espira. I-K.* "Triphora" caracca *Dall, 1927. I: lectotipo, 7,1 mm, fuera de Georgia, 805 m (USNM): J, K: paralectotipos, 6,9, 6,7 mm, la misma localidad (USNM).*

(CHL); 5 sp (Figs. 22A-22C)(one destroyed by radular study), E Palm Beach (J. Root; *ex* K. Sunderland 1991) 30 m (CHL); 5 s, SW Egmont Key, 73-92 m (Steger, 1966) (ANSP 306356); 2 s, Monroe Co. Dry Tortugas area, 25 30′ N, 59 m (FLMNH 154901); 3 s, Palm Beach Co., off Singer Id. (McGinty/Jun 1940) 183-274 m (FLMNH 257141); 2 s, Palm Beach Co., off Palm Beach (McGinty/Jan 1950) 92 m (FLMNH 205145); 8 s, Palm Beach Co., reefs (D. Akers/1970-1971) 30 m (FLMNH 127829); 15 sp, Palm Beach Co., off Delray Beach, Manalapan Wreck (McGinty), 10 m (FLMNH 249896); 1 s, Palm Beach Co., off Yamato Rocks (F. B. Lyman/ Apr 1939) 11 m (FLMNH 10242). Bahamas: 2 s, Indian Cay, Grand Bahama Island 26° 42′ 45″N, 78° 39′ 15″W (Worsfold) (ANSP 366953).

Description: Rolán and Fernández-Garcés (1995). Shell (Figs. 22A-22C) light brown with the protoconch darker.

Radula (Figs. 22G, 22H): With the formula 4-1-1-1-4. Central tooth divided in two parts by a deep separation. Each of these two prominences finishes in four short sharp pointed cusps. Lateral teeth elongate and with the form of a half tube, the end curved with 6-7 pointed and short cusps. Four marginal teeth in each side, flat, elongate, and at their ends are about 15-17 very fine and elongate cusps, which are shorter on one side and more elongate on the other.

Dimensions: The holotype measures 4.5 mm. Some shells can reach up to 5.0 mm.

Distribution: Known from Florida, Bahamas and Cuba.

Remarks: This species was described without a generic assignment, as no soft parts were studied. With the present material it was possible to study the radula from dried animals retracted into the shell. This radula proved to be very different from all those previously known, and for this reason the creation of a new genus was considered, but it seemed preferable to place the species provisionally in a known genus that had the most similar radula. In this case we found that the genus *Sagenotriphora* is almost the only one in which the rachidian tooth is divided into two parts, although it has only one wide lateral and one marginal, contrary to the four that are found in the present species.

Sagenotriphora osclausum had been considered by some malacologists (the label of most of the studied material) to be *Triphora dupliniana* Olsson, 1916. This taxon is a fossil species and it may be differentiated by the shorter shell and the open siphonal canal.

Sagenotriphora candidula spec. nov. Rolán and Lee (Figs. 23A-F)

Type material: Holotype (Figs. 23A, 23B) in FLMNH. Paratypes: 1 s (Fig. 23C) in BMSM; 1 s, in USNM; all from the type locality and *ex* CHL. Other paratypes: 3 s, off Anna Maria Island, Manatee Co., Florida (J. Moore/*Cavalier*, 1962), 15-30 m (CHL); 4 s, SW of Egmont Key, Florida (Steger, 1996) 40-50 m (ANSP 306346); 10 s, East Tampa Bay, Florida (C. L. Richardson) (ANSP 335494); 5 s, Palm Beach Co., Florida (McGinty, Jul/1941) 55-73 m (FLMNH 249739); 2 s, Hillsborough Co., W of Egmont Key, Florida (J. Moore, 1962) 183 m (FLMNH 249838); 1 s, Palm Beach Co., reefs, Florida (D. Akers, 1970-1971) 30 m (FLMNH 127829); 13 sp, Palm Beach Co., off Delray Beach, Manalapan Wreck, Florida (McGinty), 10 m (FLMNH 249896); 1 s, Palm Beach Co., off Singer Island, Florida (McGinty, Jun/1940) 30 m (FLMNH 178388); 1 s, Palm Beach Co., Breakers Hotel, (McGinty, Jun/1940) 30 m (FLMNH 154860).

Other material studied: Florida: 7 s and f, SW of Egmont Key (Steger, 1996) 40-50 m (ANSP); 2 sp (destroyed for radular studies), type locality (CHL); 11 s, in poor condition, East Tampa Bay (C. L. Richardson) (ANSP 335494); 2 s, in poor condition, St. Augustine (FLMNH 286017).

Type locality: beach drift, Captiva Island, Florida.

Etymology: The specific name is the Latin word *candidula* which means "shining white" (diminutive) and alludes to the colour of the shell.

Description: Shell (Figs. 23A-23C) elongate, solid. Protoconch (Fig. 23D) of almost 4 whorls, apex with rounded tubercles and the whorls with two spiral threads crossed by small undulating axial ribs. The beginning of the teleoconch has two spirals, spi-

Figure 24. A-E. "*Triphora*" *georgiana* Dall, 1927. A: lectotype, 7.5 mm, off Georgia, 805 m (USNM); B-E: paralectotypes, 6.0, 4.9, 5.0, 4.1 mm, same locality (USNM). F, G. "*Triphora*" *indigena* Dall, 1927. F: lectotype, 6.6 mm, off Georgia, 805 m (USNM): G: paralectotype, 3.3 mm, same locality (USNM). H. "*Triphora*" *lilacina*, lectotype, 8.5 mm, Turtle Harbor, Florida, 11 m (USNM 83087). I-O. "*Triphora*" cf. *lilacina* (Dall, 1889). I: shell, 7.5 mm, Pinellas Co., Florida (FLMNH); J: shell, 9.0 mm, Monroe Co., Florida (FLMNH); K: shell, 8.0 mm, Palm Beach Co., Florida (FLMNH); L: shell, SEM photo, 4.1 mm, Pickles Reef, off Key Largo, 5 m (CHL); M: apical part with protoconch, shell in figure J; N: protoconch of shell in Figure L; O: detail of the last whorl from shell in Figure I.
Figura 24. A-E. "Triphora" georgiana *Dall, 1927. A: lectotipo, 7,5 mm, fuera de Georgia, 805 m (USNM); B-E: paralectotipos, 6,0, 4,9, 5,0, 4,1 mm, de la misma localidad (USNM). F, G.* "Triphora" indigena *Dall, 1927. F: lectotipo, 6,6 mm, fuera de Georgia, 805 m (USNM): G: paralectotipo, 3.3 mm, la misma localidad (USNM). H.* "Triphora" lilacina, *lectotipo, 8,5 mm, Turtle Harbor, Florida, 11 m (USNM 83087). I-O.* "Triphora" *cf.* lilacina *(Dall, 1889). I: concha, 7,5 mm, Pinellas Co., Florida (FLMNH); J: concha, 9,0 mm, Monroe Co., Florida (FLMNH); K: concha, 8,0 mm, Palm Beach Co., Florida (FLMNH); L: concha, SEM photo, 4,1 mm, Pickles Reef, fuera de Cayo Largo, 5 m (CHL); M: parte apical con protoconcha, concha de la Figura J; N: protoconcha de la concha de la Figura L; O: detalle de la última vuelta de la concha de la Figura I.*

ral 1 very close to the suture and spiral 3 in the middle of the whorl. About the fourth-fifth whorl spiral 2 appears in the middle of the space between the other two, enlarging quickly and becoming equal to spirals 1 and 3 on the subsequent two whorls. A very fine spiral thread appears at the suture. Aperture oval elongate. Siphonal canal very short, closed by the continuation of the outer lip. Colour: protoconch brown and the teleoconch uniformly creamy-white; small areas of cream or light brown may be visible on the base and inside the aperture. Operculum multispiral (Fig. 23E) ovoid, yellowish, translucent.

Dimensions: The holoype measures 5.0 mm.

Distribution: Known from Florida coasts.

Due to the scarcity of available material, our radular study was limited to only two specimens. Unfortunatly, only a little information could be obtained and the radula could not be photographed (see Fig. 23F). The radula (formula 3-1-1-1-3) has a central tooth with two upward cusps and two more externally and in the opposite direction. The lateral teeth have a sharp border with many small cusps. The marginal has only a few cusps.

Remarks: This species had been considered by collectors to be conspecific with the previous one (*S. osclausum*), which is similar but light brown in colour. However, the difference in the radula indicated that they were different species.

S. candidula spec. nov. must be differentiated from the white *Cosmotriphora melanura* (C. B. Adams, 1850) which is larger, with more whorls. Spiral 2 appears earlier(3-4 whorls), the colour of the teleoconch is milk white and not creamy-white, and the base is white; the apex of the protoconch is narrower; also the protoconch is consistently dark brown and not light brown, has only one spiral on the first and second whorls and is also a little larger.

Marshallora ostenta spec. nov. is not totally cream, and some spiral cords (at least the suture) may be brown or light brown; the siphonal canal is short and open and the protoconch is somewhat larger, and has one spiral cord on the first protoconch whorl.

Genus *Triphora* Blainville, 1828

Type species (by monotypy): *Triphora gemmatum* Blainville, 1828; Recent, Mauritius.

Remarks: This genus name has formerly been employed as the nominal for the family. Consequently, it is commonly used when generic assignment is not possible, as *"Triphora" sensu lato*.

"Triphora" hircus (Dall, 1881) (Fig. 36J)

Triforis hircus Dall, 1881. *Bull. Mus. Comp. Zool.*, 9: 83. [Type locality: Yucatan Strait, 640 fms (1171 m)].
Triforis (bigemma var.?) hircus Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 249, pl. 20, fig. 11.

Type material: No type in USNM (E. Strong, pers. comm.); neither in other American museums. Figured in Dall (1889: pl. 20, fig. 11) (Fig. 36J) measuring 12.5 mm.

Description: See Dall (1881). With 14 or more inflated whitish whorls. The most important characters in the original description and in the figure are the two prominent spirals, the upper one more widely separated from the suture.

Dimensions: The original description gives a dimension of 12.5 mm.

Distribution: Only known from the type material.

Remarks: Dall (1881) described this species as new; later (Dall, 1889) he revised his taxonomic opinion and he considered it to be probably a variety of *T. bigemma* Watson, 1880; but that species has only two spirals on the upper part of

Figure 25. A. *Triforis atlantica* E. A. Smith, 1890, lectotype, 6 mm, St. Helena. B-I. "*Triphora*" *atlantica*. B: shell, 6.3 mm, W Egmont Key, Hillsborough Co., Florida (CHL); C, D: shells, 7.1, 4.9 mm off Guarapari, Espiritu Santo State, Brazil, 15-20 m (CHL); E, G, H: shells, 6.7, 5.3, 4.2 mm, 42 miles E St. Augustine, St. Johns Co., Florida, 85 m (CHL); F: shell, 4.8 mm, SEM photo, Florida (FLMNH); I: protoconch of the shell in previous figure). J. "*Triphora*" *pyrrha* Henderson and Bartsch, 1914, syntype, 2.7 mm, Chincoteague (USNM).

Figura 25. A. Triforis atlantica *E. A. Smith, 1890, lectotipo, 6 mm, St. Helena. B-I.* "Triphora" atlantica. *B: concha, 6,3 mm, O Cayo Egmont, Hillsborough Co., Florida (CHL); C, D: conchas, 7,1, 4,9 mm fuera de Guarapari, Estado de Espiritu Santo, Brasil, 15-20 m (CHL); E, G, H: conchas, 6,7, 5,3, 4,2 mm, 42 miles E St. Augustine, St. Johns Co., Florida, 85 m (CHL); F: concha, 4,8 mm, SEM photo, Florida (FLMNH); I: protoconcha de la concha de la figura anterior). J.* "Triphora" pyrrha *Henderson y Bartsch, 1914, syntype, 2,7 mm, Chincoteague (USNM).*

the teleoconch, subsequently with three spirals of which spiral 1 is smaller (Watson, 1886, pl. 43, fig. 6). For these reasons both taxa have been considered here to be valid and different species.

This species has been kept here in *"Triphora"* instead of in *Inella* due to several characters found in the original description: acutely tapered apex probably rather pointed, crowded transverse sculpture (twenty-one slightly oblique ribs, etc.), and also due to the figured shape of the species.

Comparison must be made with the species having 2 main spirals, basing the differences on the teleoconch characters:

I. enopla and *I. pompona* are more cylindrical and have two small spirals besides the two main ones.

I. colon and *I. ibex* have more cylindrical shells, and the two spirals are located equidistant between the sutures.

"Triphora" cylindrella (Dall, 1881) (Fig. 36K)

Triforis cylindrella Dall, 1881. *Bull. Mus. Comp. Zool.*, 9: 83. [Type locality: Cape San Antonio, 640 fms (1171 m)].

Triforis (Sychar) cylindrella Dall, 1881. In Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 250, pl. 20, fig. 6.

Type material: No type in USNM (E. Strong, pers. comm.), AMNH (M. Sidall, pers. comm.), or ANSP. The lectotype, here designated, (Fig. 36K) is the specimen figured by Dall (1889, plate 20, fig. 6).

Description: See Dall (1881). Shell with 12-14 white whorls. The most important characters are the presence of three similar spirals and convex whorls, the lowest with more elongate nodules.

Dimensions: The original description gives a dimension of 6.5 mm.

Distribution: Only known from Cape San Antonio.

Remarks: The placement of this species in the genus *"Triphora" s. l.* is tentative and based on the original description and figure. As the type was not found, the comparison was made from the characters in the original description with the species which had three equal spirals, as follows:

I. intermedia has whorls with a flat profile, only 2 spirals at the beginning, and spiral 2 is smaller on most of the shell.

I. torticula has convex whorls, but the nodules are larger on spirals 2 and 3, and the shell is more elongate and cylindrical.

I. compsa has an unknown protoconch, so comparison is difficult; however, spiral 1 is smaller and the nodules are more prominent.

Cosmotriphora melanura is more elongate and the profile of the whorls is flat.

Sagenotriphora candidula has only two spirals at the beginning of the teleoconch and the whorls are rather flat.

"Triphora" rushii (Dall, 1889)

Triforis rushii Dall, 1889. *Bull. Mus. Comp. Zool.*, 18: 246. [Type locality: west of North Bimini Island, Bahamas, 200 fms (366 m)].

Type material: Holotype (USNM 61227) missing (Ellen Strong pers. comm.).

Description: See Dall (1889: 246). Shell with 12-14 whorls. Four spirals, of which only the lowermost is prominent, with a row of large pointed nodules. Above this are three much finer, lower and undulating threads of equal size. No ribs exist. Shell milky-white in colour.

Dimensions: 2.6 mm according to the original description.

Remarks: No other species in the studied area shows this kind of sculpture with four spirals, the lowermost the most prominent and with the largest nodules.

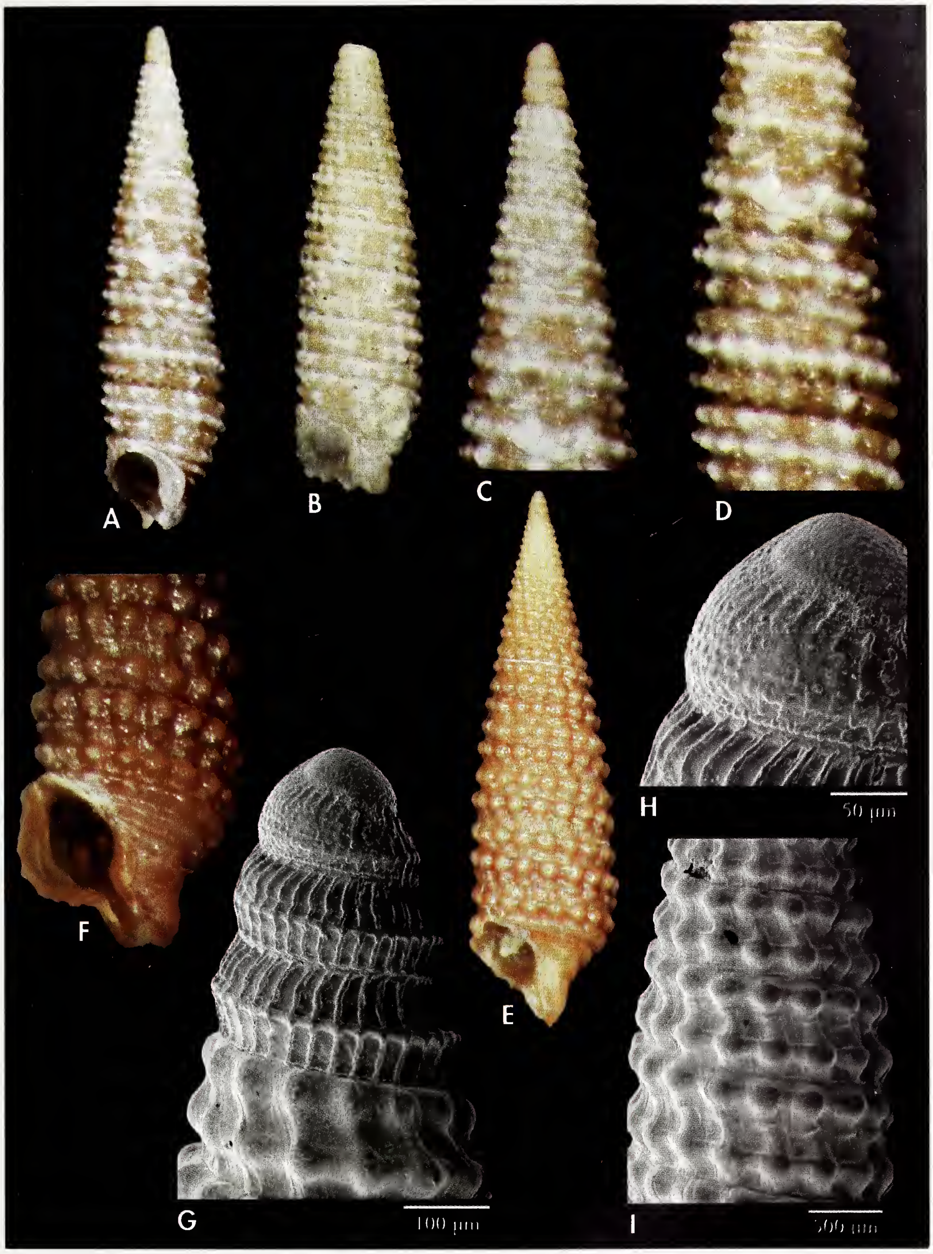

Figure 26. A-D. "*Triphora*" *inaudita* spec. nov. A: holotype, 5.4 mm, SW of Dry Tortugas (FLMNH). B: paratype, 4.4 mm (BMSM). C: details of protoconch of the holotype; D: detail of the sculpture. E-I. "*Triphora*" *pseudonovem* spec. nov. E: holotype, 7.3 mm (FLMNH); F: detail of the aperture of a paratype (FLMNH); G: protoconch; H: detail of the protoconch; I: detail of the spire of the holotype.

Figura 26. A-D. "Triphora" inaudita *spec. nov. A: holotipo, 5,4 mm, SO de Dry Tortugas (FLMNH). B: paratipo, 4,4 mm (BMSM). C: detalle de la protoconcha del holotipo; D: detalle de la escultura. E-I.* "Triphora" pseudonovem *spec. nov. E: holotipo, 7,3 mm (FLMNH); F: detalle de la abertura de un paratipo (FLMNH); G: protoconcha; H: detalle de la protoconcha; I: detalle de la espira del holotipo.*

"Triphora" abrupta (Dall, 1881) (Figs. 23G-H, 36M)

Triforis (bigemma Watson var.*) abruptus* Dall, 1881. *Bull. Mus. Comp. Zool.*, 18: 84. [Type locality: Yucatan Strait, 640 fms (1171 m)].
Triforis (Sychar) abrupta Dall, 1881. In DALL, 1889. *Bull. Mus. Comp. Zool.*, 18: 249, pl. 20, fig. 12b.

Type material: A syntype, here designated as lectotype (Figs. 23G, 23H) (MCZ 7389). The types in USNM are lost (E. Strong, pers. comm.).

Description: See DALL (1881). The lectotype is a shell without protoconch and aperture. The most important characters are that spiral 1 is formed by small, less prominent nodules; spirals 2 and 3 are more prominent and almost equal, with larger nodules. Below there is a small, smooth spiral 4.

Dimensions: according to DALL (1881) the shell measures 7.5 mm. The lectotype measures 7.9 mm.

Distribution: Only known from the type material.

Remarks: The lectotype is probably the same shell studied by Dall with the loss of the external lip, with the same size and sculpture. For this reason it is considered as lectotype. No information on protoconch and aperture are available, which makes any kind of comparison difficult. The placement in *"Triphora"* and not in *Inella* is tentative, based on the rapidly enlarging whorls.

There are only a few species with spiral 1 smaller, spirals 2 and 3 larger and similar, and spiral 4 smooth:

Inella pompona and *I. enopla* have shells lighter in colour, more elongated, lacking spiral 1 on the first teleoconch whorls, and with the space between the main spirals more depressed.

Inella apexbilirata spec. nov. has a smaller shell, narrower and almost cylindrical in profile.

"Triphora" caracca Dall, 1927 (Figs. 23I-K)

Triphora caracca Dall, 1927. *Proc. U. S. N. M.*, 70: 93. [Type locality: Off Georgia, 440 fms (805 m)].

Type material: Lectotype, here designated (Fig. 23I) and paralectotypes (Fig. 23J, 23K) (USNM 108343).

Description: See DALL (1927). Dark brown paucispiral protoconch with at least three whorls with two spiral cords. No more details can be known because of erosion. The most important differential character is that the axial ribs are very fine and strongly prosocline. Spirals 1 and 3 larger and prominent from the beginning of the teleoconch, with spiral 2 appearing about the tenth whorl and remaining very small on the final whorls.

Dimensions: The original description gives a dimension of 7.1 mm.

Distribution: Only known from the type material.

Remarks: The shell mentioned by DALL (1927) measured 8 mm, but the lectotype examined from USNM only reached 7.1 mm, which could be due to the loss of one whorl. No other triphorid in the Caribbean has spiral 2 beginning on the tenth whorl and remaining small and close to spiral 1 down to the end of the spire.

"Triphora" georgiana Dall, 1927 (Figs. 24A-E)

Triphora (Biforina) georgiana, Dall, 1927. *Proc. U. S. N. M.*, 70: 93 [Type locality: Off Georgia].

Type material: Lectotype, here designated (Fig. 24A) with 15 whorls and 5 paralectotypes (Figs. 24B-24E) (USNM 333516).

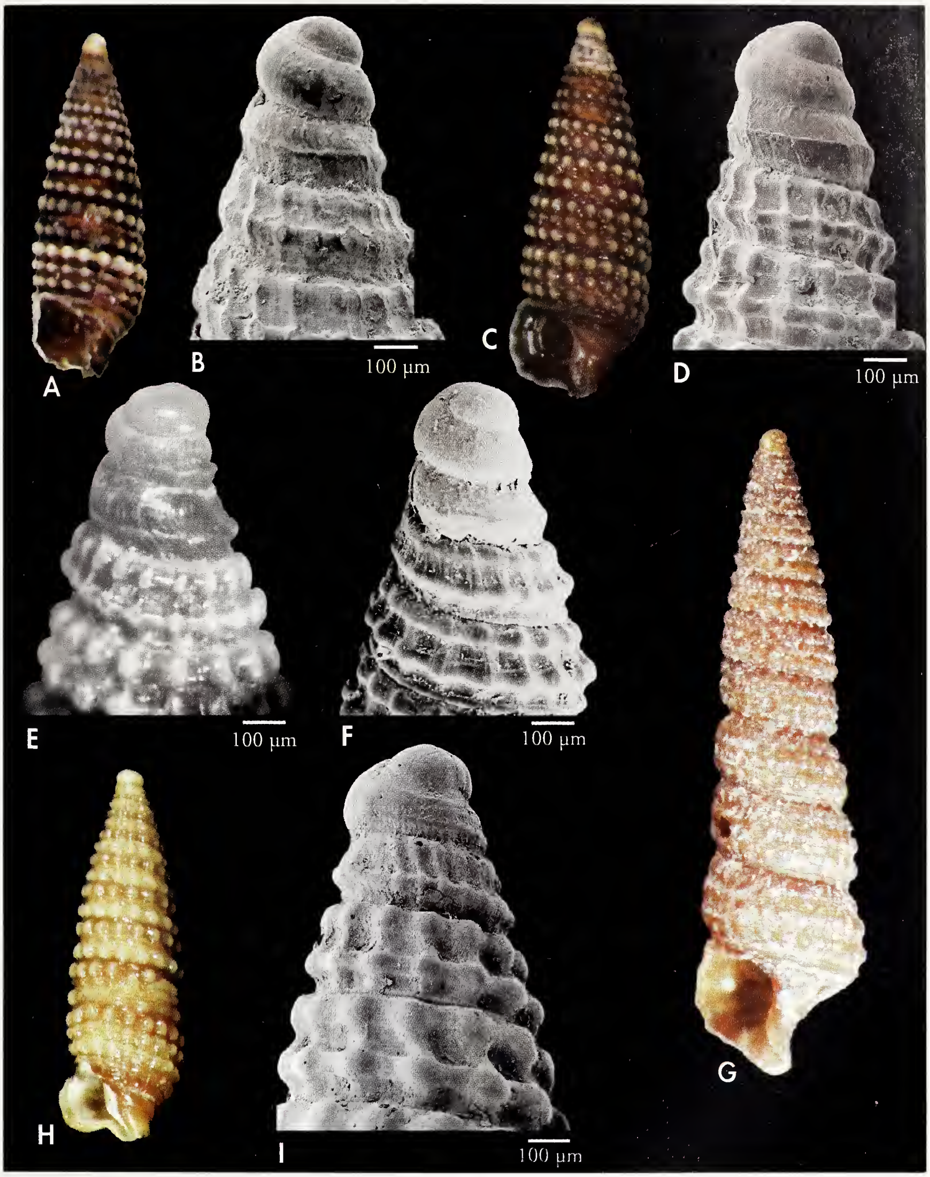

Figure 27. A-F. "*Triphora" calva* (Faber and Moolenbeek, 1991). A: shell, 3.7 mm, Key Largo, Florida (CMK); B: protoconch of the previous shell; C: shell, 3.7 mm, Key Matias, Cuba (MHNS); D: protoconch, Cienfuegos, Cuba (CFG); E: protoconch, Santa Lucia, Pinar del Río, Cuba (CFG); F: protoconch, Abaco, Bahamas (CCR); G: "*Triphora*" cf. *calva*, shell, 6.8 mm, Grand Bahama Island (ANSP). H, I. "*Triphora" yociusi* spec. nov. H: holotype, 3.9 mm, off St. Augustine, St. Johns Co., Florida (FMNH); I: protoconch of the paratype.

Figura 27. A-F. "Triphora" calva *(Faber and Moolenbeek, 1991). A: concha, 3,7 mm, Cayo Largo, Florida (CMK); B: protoconcha de la concha anterior; C: concha, 3,7 mm, Cayo Matías, Cuba (MHNS); D: protoconcha, Cienfuegos, Cuba (CFG); E: protoconcha, Santa Lucia, Pinar del Río, Cuba (CFG); F: protoconcha, Abaco, Bahamas (CCR); G:* "Triphora" *cf.* calva, *concha, 6,8 mm, Grand Bahama (ANSP). H, I.* "Triphora" yociusi *spec. nov. H: holotipo, 3,9 mm, fuera de St. Augustine, St. Johns Co., Florida (FMNH); I: protoconcha del paratipo.*

Description: See DALL (1927). It is relevant that the protoconch was described as having a smooth nucleus and 2 more whorls sculptured with two spiral threads and numerous "flexuous axial threadlets". Probably all the protoconchs are eroded, so the exact form and sculpture could only be known after the examination of fresh shells. The teleoconch has spirals 2 and 3 from the beginning; later a very weak spiral 1 appears below the suture, and remains the smallest one up to the end. Spiral 2 is the largest and most prominent.

Dimensions: The lectotype measures 7.5 mm.

Distribution: Only known from the type material.

Remarks: MARSHALL (1983) considered the genus *Biforina* to be a synonym of *Monophorus* Granata-Grillo, 1877. As there is no information on the radula, it seems better to keep it in "*Triphora*" in *sensu lato*.

The shell designated as lectotype had been separated from the rest of the lot in a different capsule with the indication "type". This shell has the dimensions and number of whorls given by the author. Because no holotype was mentioned in the original description, this shell must be designated as lectotype.

This species shows some resemblance to *Strobiligera brychia* (Bouchet and Guillemot, 1978) (Fig. 14F) in its teleoconch whorls, but apparently the protoconch of the latter species is more pointed and has more whorls.

"*Triphora*" *indigena* Dall, 1927 (Figs. 24F-G)

Triphora indigena Dall, 1927. *Proc. U. S. N. M.*, 70: 93. [Type locality: Off Georgia, 805 m].

Type material: Lectotype, here designated (Fig. 24F) with 13 whorls, and a paralectotype (Fig. 24G) (USNM 108079).

Description: See DALL (1927). Protoconch multispiral, a little eroded on the paralectotype but apparently brown with two spiral cords. The teleoconch begins with three almost similar spirals, with spiral 1 becoming smaller on subsequent whorls, appearing as a small thread very close to the suture. The cords and ribs are rather elevated, and cross to form rectangular interspaces.

Dimensions: The lectotype measures 6.6 mm.

Distribution: Georgia and Fernandina (mentioned in the original description).

Remarks: Its most important character is the formation of rectangular spaces between cords and ribs. Spiral 1 is smaller throughout the spire, the other two being similar to each other.

There are no similar species in the study area.

"*Triphora*" *lilacina* (Dall, 1889) (Fig. 24H)

Triforis lilacina Dall, 1889. *Bull. M. C. Z.*, 18: 243. [Type locality: Turtle Harbor, Florida, USA].

Type material: One syntype (Fig. 24H) here designated as lectotype (USNM 83087).

Description: See DALL (1889). The protoconch is unknown. The most important character is the uniform lilac colour; also, the two spirals, with an additional very narrow spiral only appearing between them on the eleventh whorl. The nodules are spherical and relatively small.

Dimensions: The lectotype measures 8.5 mm.

Remarks: The lectotype does not have exactly the characters mentioned in the original description (it measures 8.5 mm instead of 9.0 and has 15 whorls instead of 18), but these differences may be the

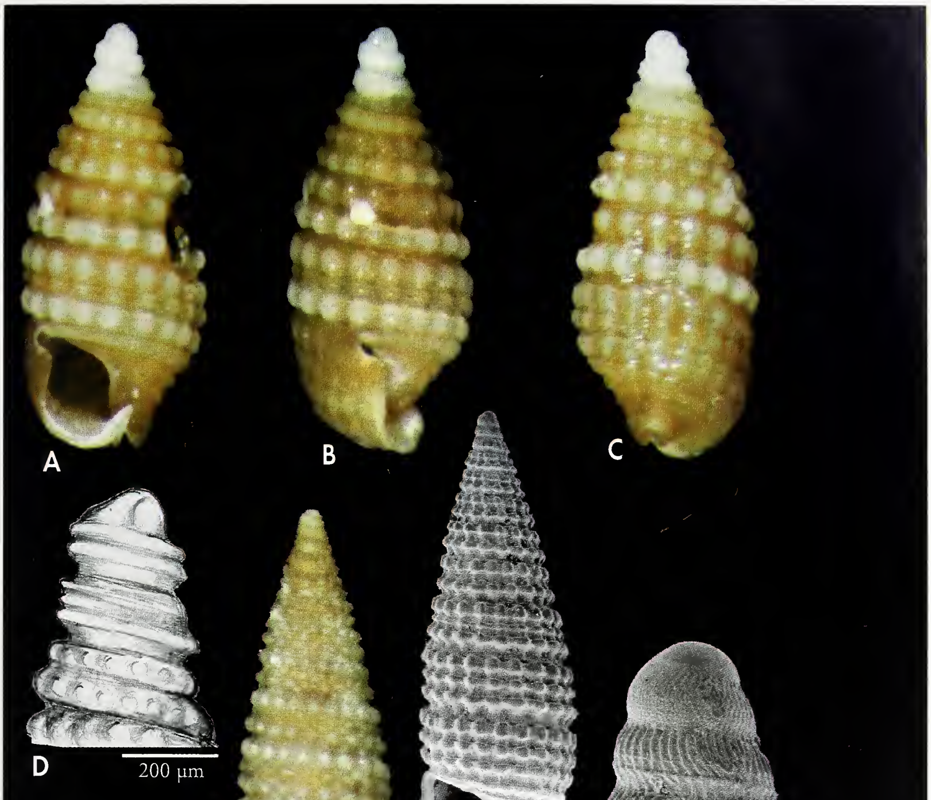

Figure 28. A-D. "*Triphora*" *guadaloupensis* spec. nov. A-C: holotype, 2.3 mm, Guadaloupe (ANSP); D: drawing of the protoconch. E-H. "*Triphora*" *amicorum* spec. nov. E, F: holotype, 4.4 mm, Florida (FLMNH); G: paratype, 3.8 mm, Florida (FLMNH); H: protoconch of the holotype.
Figura 28. A-D. "Triphora" guadaloupensis *spec. nov. A-C: holotipo, 2,3 mm, Guadalupe (ANSP); D: dibujo de la protoconcha. E-H.* "Triphora" amicorum *spec. nov. E, F: holotipo, 4,4 mm, Florida (FLMNH); G: paratipo, 3,8 mm, Florida (FLMNH); H: protoconcha del holotipo.*

result of a quick examination or due the loss of a small part of the shell (the loss of the first whorls of the protoconch was already mentioned in the original description). In spite of this, the colour is very characteristic and there is no doubt that it is the type mentioned in the original description. Besides, it is necessary to point out that the shell has a defect on the penultimate whorl, which may cause a slight deformation.

The shells illustrated by some authors under this name (Vokes and Vokes, 1983) seem to be very different.

Distribution: Only known from the type locality.

Mesophora novem (Nowell-Usticke, 1969) seems to be the closest species, but has a different colour, larger and lighter nodules, and a darker suture; spiral 2 does not appear until the final whorls and is always smaller than the other two, but it has larger nodules than those on spiral 2 of *"T." lilacina*.

No shells resembling the type of this taxon have been collected by any other author in spite of the fact that it comes from shallow water (11 m). Hence, some malacologists (pers. comm.) have considered that this type could be an abnormal individual from a population which is usually differently coloured (which we will mention below as *"Triphora" atlantica*).

Another possibility is the one suggested by several persons (pers. comm.): if the lectotype is an abnormal shell with an uncommon colour for the species, it may be conspecific with shells from other populations having different morphological form and colour. One candidate for this is presented below as "*T.*" cf. *lilacina*.

"Triphora" cf. *lilacina* (Figs. 24I-O)

Material examined: Florida: 1 s (Fig. 24J), 24° 50′ N, Monroe Co., West Coast of Florida (Jun 1961) (McGinty coll.) 61 m (FLMNH 259042); 6 s (Fig. 24I) Pinellas Co., SSW John's Pass (Dan Steger) 55 m (FLMNH 238675); 1 s (Fig. 24L), Pickles Reef, off Key Largo, Monroe Co. (L. Hill, May/76), 7-10 m (CHL); 1 s, Palm Beach Co., Breakers Hotel to Biltmore Hotel (R/V Triton, Apr 1951) (McGinty coll.) 36-55 m (FLMNH 177402); 1 s, Monroe Co., off Dry Tortugas (R. Black, dec. 1990) 960 m (FLMNH 279375); 1 s, Palm Beach Co., Boynton Beach, off Briny Breezes (R/V Triton, Feb 1951) (McGinty coll.) 50-60 fms (FLMNH 219907); 2 s, Collier Co., SW of John's Pass (Powlus and Steger, May 1958) (McGinty coll.) 55 m (FLMNH 154900); 2 s, Collier Co., 150 miles W (J. Moore, Jun. 1962) (M. Hunter coll.) Cape Romano, 450 m (FLMNH 129846); 1 s (Fig. 24K), Palm Beach Co., Bath and Tennis Club to Palm Beach Pier (R/V Triton, Apr. 1951) (McGinty coll.) 36-55 m (FLMNH 176649); 1 s, Palm Beach Co.(R/V Triton, Apr. 1950) 40-50 m (FLMNH 204877).

Description: Shell (Figs. 24I-24L) solid, elongated, light brown. Protoconch (Fig. 24N) multispiral, with about 4 whorls, the apex surface with small tubercles and the subsequent whorls with two spiral cordlets crossed by numerous fine axial ribs that are slightly S-shaped, especially on the last whorl. Teleoconch with about 11-12 whorls, beginning with spirals 1 and 3, crossed by prosocline small axial ribs which form nodules at the intersection points. These two spirals continue on the subsequent whorls, the upper one with slightly larger nodules; on about the sixth-eighth whorl, a very small spiral 2 appears close to spiral 1; on the subsequent whorls, this spiral 2 enlarges slightly until it is almost similar in size to spiral 3, spiral 1 is always slightly larger with larger nodules. On about the tenth whorl an additional spiral cord appears; this cord is smooth, always smaller, and located just below the lower suture, but on the final whorl it is more obvious and beaded. Below it there are two more spiral cords, the upper one slightly nodulous and the lower one smooth, located on the base of the siphonal canal. Aperture rounded-ovoid, columella curved, siphonal canal elongate and recurved, closed at its base by an extension of the aperture.

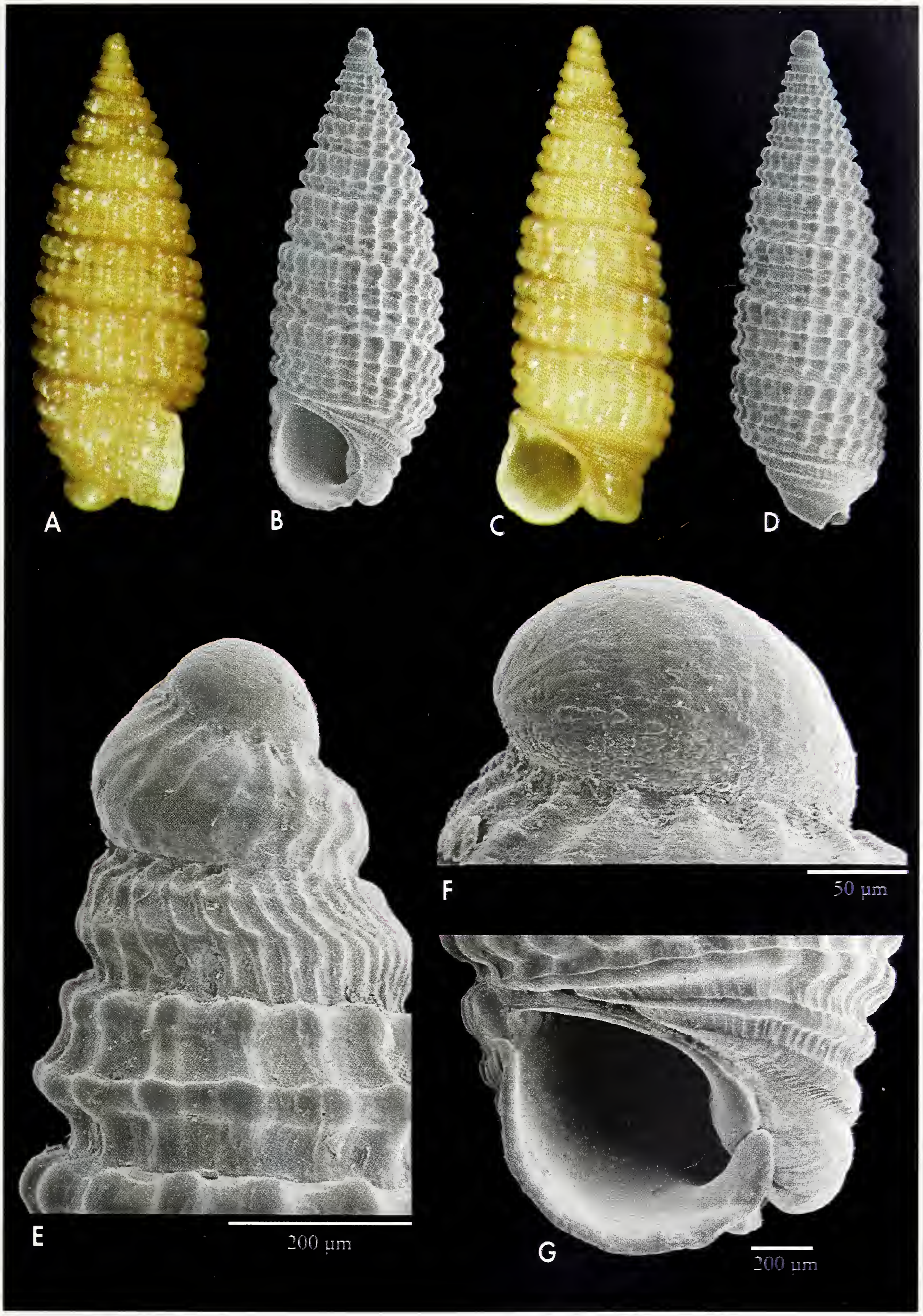

Figure 29. "*Triphora*" *turtlebayensis* spec. nov. A, B: holotype, 4.1 mm, Bermuda (FLMNH); C, D: paratype, 4.2 mm (BMSM); E: protoconch of the holotype; F: detail of the protoconch of the paratype; G: detail of the aperture and base.

Figura 29. "Triphora" turtlebayensis *spec. nov. A, B: holotipo, 4,1 mm, Bermudas (FLMNH); C, D: paratipo, 4,2 mm (BMSM); E: protoconcha del holotipo; F: detalle de la protoconcha del paratipo; G: detalle de la abertura y de la base.*

The colour is brown on the protoconch; light brown on the shell, spiral 1 having lighter nodules, more evident on the last whorls.

Dimensions: The shells studied measure between 4.0 and 9.0 mm.

Distribution: Only known from Florida.

Remarks: The shells figured by ABBOTT (1974) as *T. lilacina* may belong to this taxon. If the present well defined species is "*T.*" *lilacina*, the only explanation would be that the lectotype of that taxon is an abnormally coloured shell, in which case the synonymy would only be acceptable if intergrades were found. On the other hand, if additional examples of the typical lilac shells of "*Triphora*" *lilacina* were collected in the future, showing consistent differences with the shells described here, then the shells referred here as "*Triphora*" cf. *lilacina* could be named as a different species.

"*Triphora*" *atlantica* (E. A. Smith, 1890) (Figs. 25A-I)

Triforis atlantica E. A. Smith, 1890. *Proc. Zool. Soc. Lond.*, 18: 292, pl. 21, fig. 16.
Triphora lilacina Dall, 1889. In Abbott, 1974: 112.

Type material: Lectotype, here designated, of *Triforis atlantica* (Fig. 25A) and several paralectotypes (BMNH 89.10.1.1874-93).

Other material examined: USA: Florida: 1 s (Fig. 25B), W Egmont Key, Hillsborough Co. (Gulf of Mexico) (Jim Moore/*Cavalier*, 1962), 76 m (CHL); 2 s, off Palm Beach (M. Glickstein, 1980) 82-105 m (CHL); 3 s (Figs. 25E-25G), 42 miles E St. Augustine, St. Johns Co. (T. Yocius, 1979), 85 m (CHL); 2 s (Fig. 25E, G), 42 miles E St. Augustine, St. Johns Co. (T. Yocius, Jul/1980), 36 m (CHL); 1 s, 50 miles S Carrabelle, Franklin Co. (J. Keeler, Feb/1986), 60 m (CHL); 2 s, W Marco, Collier Co. (J. Moore/*Cavalier*, 1972) 55 m (CHL); 1 s, Monroe Co., West coast, 24° 50′ N, 33 fms (FLMNH 259042); 3 s, Palm Beach Co. (D. Akers, 1970-1971) 30 m (FLMNH 127891); 1 s, Palm Beach Co., off Boynton Inlet (D. and H. Akers, Sep. 1970) 36 m (FLMNH 228682). Louisiana: 2 s, off Louisiana, 26° 06.8′ 66N 91° 02.418W (E.F. Garcia/*Pelican*, Jun/2001 57-65 m (CHL); 1 s, off extreme W Louisiana, 29° 45.9′ N 13° 02.8′ W, (E.F. Garcia/*Pelican*, Sept/98) 55-65 m (CHL); 1 s, off Louisiana, 28° 05.61N 91° 02.206′ W (E.F. Garcia/*Pelican*, Jun/2000), 58 m (CHL); Puerto Rico: 2 s, Rincon (L. Germaine, Apr/1961) 30 m (FLMNH 163833). Brazil: 3 sp. (Figs. 25C, 25D) off Guarapari, Espiritu Santo State (R. Bodart, 1994) 15-20 m (CHL).

Description: Shell (Figs. 25A-25H) sharp-pointed, elongate, solid, with bands of brown and white. Protoconch multispiral (Fig. 25I) with the apex reticulated and 4 whorls with narrow axial ribs that cross a single thread on the first whorl and 2 elsewhere, except at the end where there is only one. Teleoconch with about 12-13 whorls, sometimes more on large shells, beginning with spirals 1 and 3, crossed by prosocline axial ribs which form nodules at the intersection points. These two spirals continue on the subsequent whorls, the upper one white and with slightly larger nodules; on about the eighth-ninth whorl, a very small spiral 2 appears close to spiral 1; on the subsequent whorls, this spiral 2 enlarges slightly until it is almost similar in size to spiral 3, spiral 1 continuing to have larger, more prominent white nodules. On about the tenth-twelfth whorl an additional spiral cord appears; this cord is only slightly nodulous, always smaller, and located just below the lower suture, but on the final whorl it is more obvious, is located near the periphery and has larger nodules. Below it there are two more spiral cords, the upper one slightly nodulous and the lower one smooth, located on the base of the siphonal canal. Aperture rounded-ovoid, columella curved, siphonal canal elongate and recurved, closed at its base by an extension of the aperture.

The colour is dark brown on the protoconch; white on the first two teleoconch whorls, subsequently with white nodules on spiral 1 and light brown in

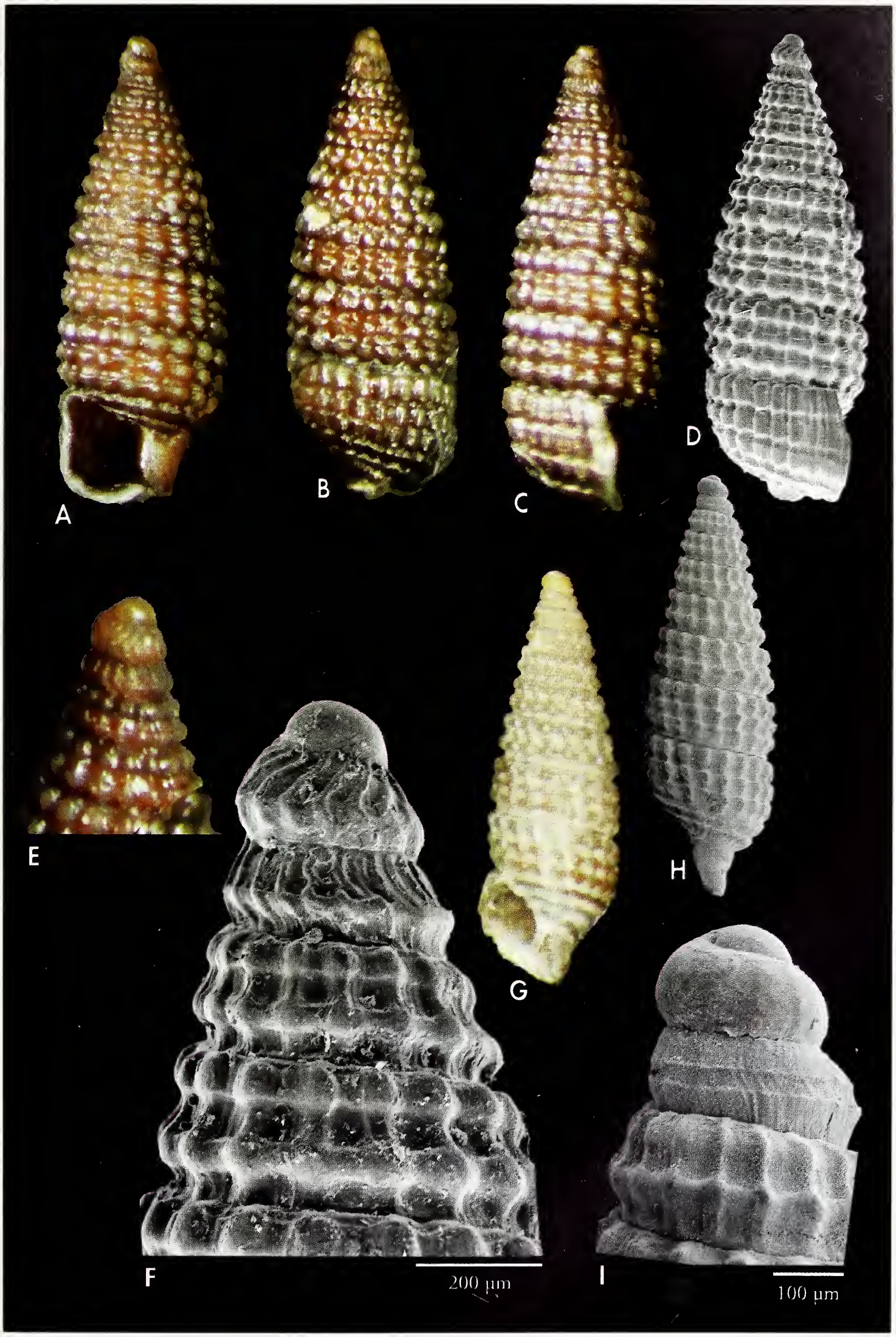

Figure 30. A-F. "*Triphora*" *grenadensis* spec. nov. A-D: holotype, 3.2 mm, Grenada (ANSP); E, F: protoconch of the holotype. G-I. "*Triphora*" sp. 1, 3.5 mm, British Honduras (Belize) (ANSP).
Figura 30. A-F. "Triphora" grenadensis *spec. nov. A-D: holotipo, 3,2 mm, Granada (ANSP); E, F: protoconcha del holotipo. G-I.* "Triphora" *sp. 1, 3,5 mm, British Honduras (Belize) (ANSP).*

the interspaces; the background colour of spiral 2 is brownish, with the nodules somewhat lighter. On some shells the colour is similar but lighter throughout.

Dimensions: The lectotype measures 6.0 mm. Some shells from the Caribbean can reach up to 9.0 mm.

Distribution: It is known from Florida to Brazil (not collected in Cuba). Otherwise, St. Helena, in the middle of the Atlantic is the type locality of *T. atlantica*.

Remarks: This taxon is very confused, and for many years it was considered by some authors and collectors to be *T. lilacina*. Yet the lectotype of *T. lilacina* is uniform pink-lilac, spirals 1 and 3 are well developed and spiral 2 never reaches the size of the other two. The nodules are the same colour as the shell and are not lighter, and there are no differences between the colour of spiral 1 and spiral 3. No intergrades between these two morphs were found. Furthermore, the nodules are smaller and the protoconch more sharply pointed with tubercles on the apex. However, a definitive conclusion can not be reached until enough material of true *"T." lilacina* becomes available for examination, allowing a proper comparison and a study of the animal and radula.

On the other hand, the taxon *"T." atlantica* described by Smith from St. Helena is a shell with constant brown and white colouration and distribution of the bands, and with nodules of similar size. The location of the type locality in the middle of the Atlantic is not a problem for a species which has a multispiral protoconch. The only problem is that the protoconch of the holotype is not known, but the eroded protoconch of a paralectotype showed 2 spiral threads, which is compatible with that of the present population. Therefore we suggest that the shells studied from the Caribbean belong to this taxon, the only doubts being due to the lack of a good protoconch from the St. Helena material. Provisionally this species must therefore be kept under this name, awaiting the information that new material will provide in the future.

It may be confused with *Monophorus ateralbus* Rolán and Fernández-Garcés, 1994, but the latter species is smaller and has a totally different colour pattern, with the lower band white in contrast to that of *"T." atlantica*, on which the white spiral is always the upper one. *Triphora ellyae* De Jong and Coomans, 1988 is smaller and does not reach 4 mm.

"Triphora" pyrrha Henderson and Bartsch, 1914 (Fig. 25J)

Triphoris pyrrha Henderson and Bartsch, 1914. Proc. U.S.N.M. 47: 413, pl. 2, f. 4 [Type locality: Chincoteague, Virginia, USA].

Type material: A syntype (Fig. 25J) here designated as lectotype (USNM 252571).

Description: Henderson and Bartsch (1914). The lectotype is a shell in poor condition, white or cream in colour, or possibly faded brown. The protoconch is multispiral and has about 4 whorls but is very eroded, and further details are impossible to discern. The next 3 whorls have 2 spirals close together; on the following whorls, these cords 1-3 are more separate; subsequently a narrow spiral 2 appears in the middle of the whorls; on the final whorl spiral 2 is similar in size to the other two. The siphonal canal is short and open.

Dimensions: The lectotype measures 2.7 mm.

Distribution: Only known from its type locality.

Remarks: Due to the lack of information on the protoconch, the validity of this species must be confirmed by the examination of more material from the type locality. It is somewhat similar to *Marshallora modesta* or *M. nigrocincta*, but is probably a valid species.

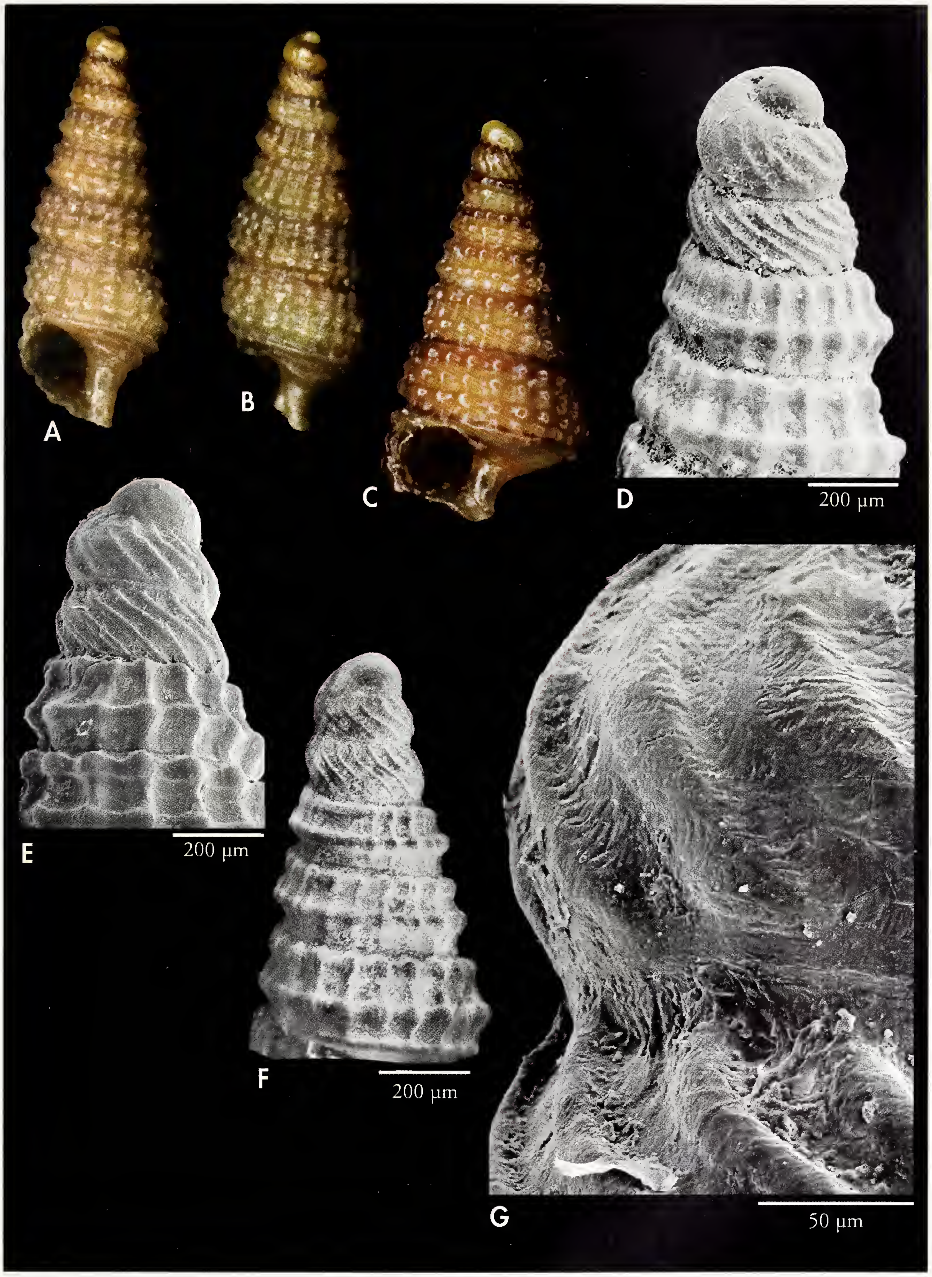

Figure 31. "*Triphora*" *abacoensis* spec. nov. A, B: holotype, 2.5 mm, Abaco, Bahamas (BMSM); C: paratype, 2.25 mm, Abaco, Bahamas (CCR); D: protoconch of paratype, Abaco, Bahamas (MHNS); E: protoconch of paratype, Abaco, Bahamas (CCR); F: protoconch, Cienfuegos, Cuba (MHNS); G: detail of the microsculpture of Figure E.

Figura 31. "Triphora" abacoensis *spec. nov. A, B: holotipo, 2,5 mm, Abaco, Bahamas (BMSM); C: paratipo, 2.25 mm, Abaco, Bahamas (CCR); D: protoconcha de un paratipo, Abaco, Bahamas (MHNS); E: protoconcha de un paratipo, Abaco, Bahamas (CCR); F: protoconcha, Cienfuegos, Cuba (MHNS); G: detalle de la microescultura de la Figura E.*

"Triphora" inaudita spec. nov. Rolán and Lee (Figs. 26A-D)

Type material: Holotype (Fig. 26A) in FLMNH; paratype (Fig. 26B) in BMSM from 28° 05.61′ N, 91° 02.205′ W to 29° 05.524′ N, 91° 02.086′ W (E.F. Garcia/*Pelican* 5/27/00) 58 m (both *ex* CHL).
Type locality: SW Dry Tortugas, Florida, USA 26° 42.9′ N, 83° 43.20′ W, 73.3-78.5 m.
Etymology: The specific name derives from the Latin word *inauditus*, which means "uncommon, unheard-of", referring to some curious characters of the shell.

Description: Shell (Figs. 26A, 26B)) very distinctive, solid, elongate. Protoconch (Fig. 26C) with 3 and $^{1}/_{2}$ whorls with two spiral cords crossed by axial ribs. Teleoconch (Fig. 26D) with three spirals from the beginning, crossed by slightly prosocline axial ribs and forming nodules at the intersections. Spiral 1 is very small on the first whorls and is located very near to spiral 2; spirals 2 and 3 are similar in size. On the subsequent whorls, spiral 1 increases in size until it reaches a size similar to spiral 2 on about the tenth whorl, but is still less prominent. Throughout the shell spirals 1 and 2 are closer than spirals 2 and 3. On the last whorl three additional spirals appear towards the base. Aperture ovoid, almost rhomboid, with a short and open siphonal canal. The colour is very characteristic: spiral 1 is mainly brown, with 1-2 white nodules alternating with 1-3 brown ones; spiral 2 is mainly white, with only a small area of brown on the lower part of some nodules; on spiral 3 the brown colour predominates, but white nodules appear between two or more brown ones.

Dimensions: The holotype measures 5.4 mm and the paratype 4.4 mm.

Distribution: Only known from the type locality.

Remarks: Some of the characters of *"T." inaudita* are totally different from any other species from the study area and therefore it has been named in spite of the scarcity of available material. The colour pattern, the smaller spiral 1 and the proximity of spirals 1 and 2 are the most important differential characters. The most similar species are:

"Triphora" cf. atlantica has two spirals on the first whorls, the nodules of the upper spiral are white and larger, while the rest are brown.

Cosmotriphora arnoldoi Faber and Moolenbeek, 1991 has uniform blotches of brown on a white background, spiral 2 does not exist on the first whorls and is smaller on the final ones.

Monophorus olivaceus has the lowermost spiral totally white; this spiral is larger on the first whorls, while spiral 2 is the smallest when it appears. Spirals 1 and 2 have only a few white nodules.

Nototriphora decorata (C. B. Adams, 1850) has three spirals similar and equidistant throughout the shell, the brown blotches are isolated on the whorls against a white background.

"Triphora" pseudonovem spec. nov. Rolán and Fernández-Garcés (Figs. 26E-I)

Type material: Holotype (Fig. 26E) and 2 paratypes in FLMNH (193355).
Type locality: Barnegat Bay, Massachusetts, USA.
Etymology: The specific name alludes to the similarity with *Mesophora novem*.

Description: Shell (Fig. 26E) subconical elongate, solid. Protoconch (Figs. 26G, 16H) with 3 $^{1}/_{2}$ whorls and a diameter of about 300 µm. The nucleus is tuberculated and is followed by one spiral thread crossed by numerous slightly opisthocline axial ribs. Teleoconch with about 14 whorls, spirals 1 and 3 appearing beaded at the beginning, with the ribs clearly prosocline; on the subsequent whorls the spirals slowly become more widely separated. The nodules are large and spherical, of similar size on both spirals, the upper nodules connected to the lower ones by well defined and slightly curved proso-

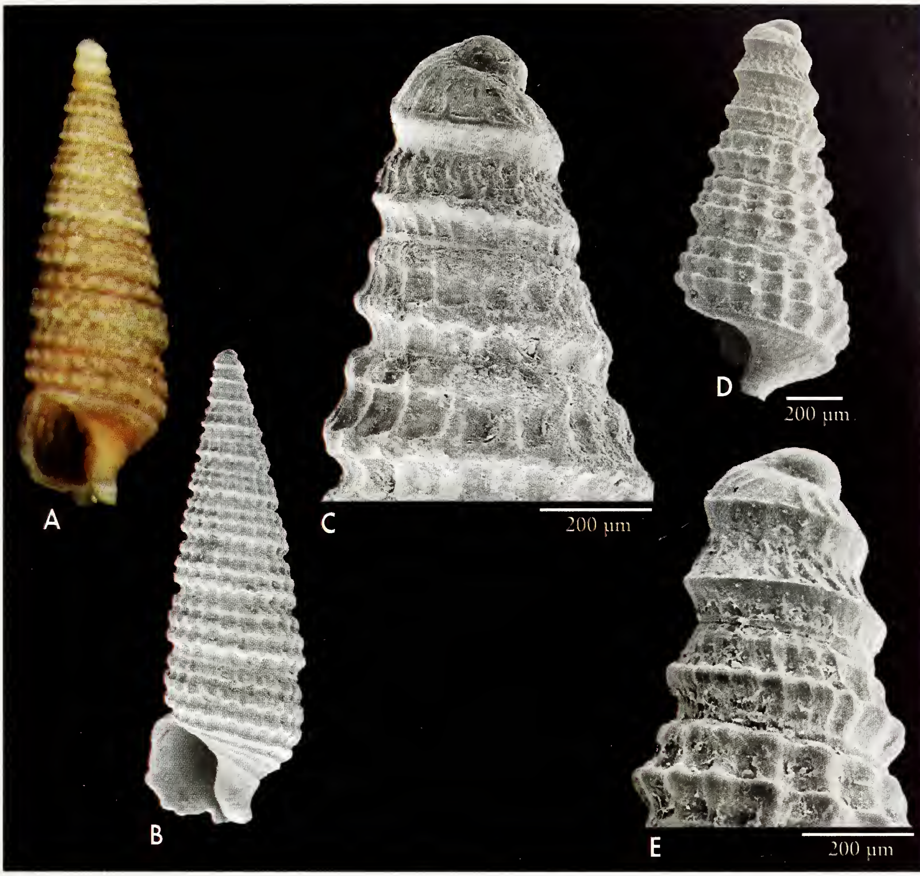

Figure 32. "*Triphora*" *portoricensis* spec. nov. A, B: holotype, 4.4 mm, Puerto Rico (FLMNH); C: protoconch of the holotype; D: paratype, 1.8 mm, Abaco, Bahamas (CCR); E: protoconch of the paratype.

Figura 32. "Triphora" portoricensis *spec. nov. A, B: holotipo, 4,4 mm, Puerto Rico (FLMNH); C: protoconcha del holotipo; D: paratipo, 1,8 mm, Abaco, Bahamas (CCR); E: protoconcha del paratipo.*

cline axial ribs (Fig. 26I). Spiral 2 appears between the other two spirals on the final two or three whorls; it is very fine and is located very close to spiral 1, not increasing immediately in size and remaining clearly smaller than the other two on the final whorl. Towards the base there are three more nodulous spirals. Aperture rounded, small, opened to the siphonal canal, which is curved and a little smaller in size than the height of the aperture (Fig. 26F).

The entire shell is brown, with the nodules a little lighter.

Dimensions: The holotype measures 7.3 mm.

Distribution: Only known from the type locality.

Remarks: This species has some of the characters of *Mesophora novem*, such as spirals 1 and 3 separated throughout most of the shell, but this new species is brownish, whereas *M. novem* is tinged with violet and has the first teleoconch whorls white; another difference is the slowly increasing size of spiral 2. The protoconch has only one spiral thread and it is shorter than that of *M. novem*.

"Triphora" calva Faber and Moolenbeek, 1991 (Figs. 27A-G)

Triphora calva Faber and Moolenbeek, 1991. *Apex*, 6(3/4): 82, figs. 3, 4. [Type locality: Key Biscayne, Florida, USA].

Type material: Holotype not examined (ZMA 391003). Represented in the original description.
Material examined: Bahamas: 1 j (Fig. 27F), Treasure Cay, Abaco 26 40.12N 77 18.19W (CCR); 5 j, North Sound, Bimini, mangrove (R. Robertson, 1957) (ANSP 329747); 3 s, Grand Bahama Island, 26° 31′ 00″N, 78° 46′ 30″W (J. Worsfold) (ANSP 373944); 1 s (Fig. 27G) Bootle Bay, Grand Bahama Island, 26° 39′ 30″N, 078° 57′ 00″ (J. Worsfold) (ANSP 371845); 6 sp, North Hawksbill Creek, Grand Bahama Island 26° 32′ 00″N, 78° 45′ 00″W (J. Worsfold) (ANSP 370520); 1 sp, 7 s, Hotel, West End, Grand Bahama Island 26° 42′ 15″N, 78° 59′ 50″W (J. Worsfold, Dec. 1981) (ANSP 368674); 1 s, McLeans Town, Grand Bahama Island, 26° 38′ 45″N, 77° 57′ 30″W (J. Worsfold) (ANSP 368484); 1 s, Hope Town Harbour, Abaco (R. Robertson, Jun. 1953) (ANSP 299409). Grand Cayman Island: 1 s, W of Prospect, SW Sound (A. J. Ostheiner) (ANSP 198925). Florida: 1 s, 1 f (Fig. 27A), Key Largo (CMK); 1 sp, 1 s, Bonefish Key (Aug. 1957) (FLMNH UF368198). Cuba: 3 s, Caibarién, (FLMNH UF365100); 1 f (Fig. 27D), Cienfuegos (CFG); 1 f, Jibacoa (MHNS); 1 f (Fig. 27E) Santa Lucia, Pinar del Rio (CFG); 3 s, Batabanó (CFG); 1 s, Cabo Matias, Canarreos (MHNS).

Description: FABER AND MOOLENBEEK (1991). The most important diagnostic characters are the following: the shell is dark brown; the brown colour may be uniform, sometimes with the nodules lighter (Fig. 27C) and even with spiral 1 on the last whorl with white nodules (Fig. 27A). The protoconch (Figs. 27B, 27D, 27E, 27F) is described as having only one smooth whorl, but if the protoconch whorls are counted by the VERDUIN (1977) method, and the end of the protoconch is at the point where the teleoconch begins with two spirals, it actually has 2 whorls (sometimes a little less); the first whorl is smooth and there is a spiral cord at the middle of the second one. In the original description there is no information on the diameter of the protoconch. Based on the photograph of the holotype it could be deduced that the protoconch is about 275 µm in width; in the material examined the diameter is variable between 250 and 380 µm. This and the brown colour are important characters for differentiation from other species.

Teleoconch sculpture begins with spiral 3; spiral 1 and axial ribs appear on the third whorl (the second whorl of the teleoconch). Spiral 2 emerges on the sixth whorl (the fifth of the teleoconch). Also another smooth sutural spiral commences on the 3th-4th whorl.

Dimensions: The holotype measures 5.0 mm. Some shells atributed to this species can reach 9 mm.

Distribution: Known from several areas of the Caribbean: Florida, Bahamas, Cuba.

Remarks: In some works (e.g. ROLÁN AND FERNÁNDEZ-GARCÉS, 2007) this species is assigned to the genus *Marshallora*. In fact there is no information on the radula and it is therefore better to keep it in *"Triphora" s. l.*

Shells from Quintana Roo were referred to in the original description under "Other material studied" to be this species; these shells were later described as *Marshallora nichupte* by ROLÁN AND CRÚZ-ÁBREGO (1996). This species can be differentiated from *"T." calva* by its more variable colour, ranging from dark brown to white, larger shell and wider protoconch, with only 1 to 1 $^1/_2$ whorls.

Below, several species are shown to be different from *"T." calva* although having a short protoconch as a common feature.

The protoconch of this species has been studied in shells from the Bahamas, Florida and Cuba (Figs. 27B, 27D, 27E, 27F), all of which have a first whorl with a similar diameter: 250, 270 µm and 260 µm respectively. Other similar characters include a smooth apex and one spiral cord on the second whorl.

One shell from the Bahamas (Fig. 27G) resembles *"T." calva* but is larger (6.8 mm) and elongated (11 whorls), and the protoconch has only one spiral whorl instead of two. It may be a different species or an abnormal individual.

"Triphora" yociusi spec. nov. Rolán and Lee (Figs. 27H, I)

Type material: Holotype (Fig. 27H) deposited in FLMNH (*ex* CHL). Paratype (Fig. 27I) in BMSM from 67 miles E St. Augustine, St. Johns Co., Florida (T. Yocius 1979) 54 m; both *ex* CHL.
Other material studied: 1 s (eroded), Bermuda (C. Abbott Davis) (ANSP 88722).
Type locality: 32 miles E St. Augustine, St. Johns Co., Florida (J. Dawley/*Scallop* 1982), 30 m.
Etymology: The species is named after Ted Yocius, the St. Augustine fisherman who dredged so many of the triphorids from off northeast Florida, including the present species.

Description: Shell (Fig. 27H) subconical elongate, solid. Protoconch (Fig. 27I) paucispiral with 1 $^3/_4$ whorls and a diameter of about 370 µm. The nucleus and most of the first whorl are smooth; near the end of this whorl two spiral cords appear. Teleoconch with about 8 whorls, with spirals 1 and 3 nodulous at the beginning. The nodules are large and rounded, of similar size on both spirals, the upper ones connected to the lower by fine prosocline axial ribs. On about the fifth whorl of the teleoconch spiral 2 appears between the other two, but closer to spiral 1; it is very narrow, subsequently increasing in size until the three spirals are similar on the final whorl. Aperture rounded, small and open to the siphonal canal, which is half the size of the aperture.

The entire shell is brown, but a darker band covers spiral 1 and reaches to the suture, the nodules on this spiral being lighter than the background colour; the nodules and the background colour of spiral 3 are cream coloured, as is spiral 2 on the last whorl.

Dimensions: The holotype measures 3.9 mm.

Distribution: Only known from type locality and area close by.

Remarks: *"Triphora" yociusi* spec. nov. has a wider protoconch than *"T". calva,* with 1 $^3/_4$ whorls, and at the end of the first protoconch whorl there are two spirals, while in *"T". calva* there is only one. The teleoconch colour is lighter and spiral 3 is cream colored, the shell is narrower, the aperture relatively smaller and the siphonal canal larger.

"Triphora" guadaloupensis spec. nov. Rolán and Fernández-Garcés (Figs. 28A-D)

Type material: Holotype (Figs. 28A-28D) ANSP (313817). Two paratypes in the same lot (ANSP). All from the type locality.
Type locality: Guadaloupe, NW of Pointe de Chateaux (Maes, Feb. 1962) 6-11 m.
Etymology: The species is named after the island where it was collected.

Description: Shell (Figs. 28A-D) very small, ovoid, short, solid. Protoconch (Fig. 28D) paucispiral, white, with 2 whorls and a diameter of about 280 µm. The nucleus is smooth and almost vertical, followed by a whorl with two spiral cords; on the second whorl an additional smaller spiral cord appears between the other two. The white colour extends no further than the protoconch, the beginning of the teleoconch being brown with two beaded cords. Teleoconch with about 4 $^1/_2$ whorls, with spirals 1 and 3 nodulous at the beginning. The nodules are large and rounded, of similar size on both spirals, the upper ones connected to the lower ones by wide orthocline ribs. On the 3rd-4th whorls, spiral 2 appears between the other two and subsequently increases in size, with the three spirals only becoming

similar on the final whorl at the end of the spire. The base has three more spiral cords, only the upper one being nodulous. Aperture ovoid, closing the siphonal canal by an extension of the outer lip; an anal notch is visible at the top of the lip.

The shell colour is brown, but the nodules on spiral 3 are always whitish-cream; the background of the spiral as well as the nodules are of this color on the final whorl, but the nodules are lighter.

Dimensions: The holotype measures 2.3 mm. Paratypes of similar size.

Distribution: Only known from Guadaloupe, and probably endemic to that island.

Remarks: This species, with two protoconch whorls bearing 2 and 3 spiral cords respectively, a very short shell with lighter beads on spiral 1 and a cream-colored spiral 3, is different from any other in the study area.

"Triphora" amicorum spec. nov. Rolán and Fernández-Garcés (Figs. 28E-H)

Type material: Holotype (Figs. 28E, 28F) and one paratype (Fig. 28G) in FLMNH (249812).
Type locality: Palm Beach Co., Lake Worth, North Inlet, Peanut Id., Florida, USA.
Etymology: The species is named after the several friends who contributed to this work with material, information and advice, and those who also helped in other ways.

Description: Shell (Figs. 28E-28F) elongate, solid. Protoconch (Fig. 28H) with 2 $^{3}/_{4}$ whorls, the apex (nucleus and first whorl) with numerous microscopic tubercles, followed by crowded axial ribs which begin below the suture; on the next whorl, the tubercles are aligned to form two threads, the upper one in the middle of the whorl and the second, a little larger and more prominent, between the first one and the suture. The axial ribs number about 40 per whorl, narrow and very close, undulating in the shape of an open S. The teleoconch begins with spirals 1 and 3, with spherical nodules that are larger on spiral 1, and with slightly orthocline axial ribs. Spiral 2 appears on the seventh whorl and is narrower, equidistant between the other two; it increases in size on the following whorls. Three more spirals on the base, the lowest one close to the siphonal canal. The colour of the shell is brown, with white nodules on spiral 1. Aperture ovoid, opened to a short siphonal canal.

Dimensions: The holotype measures 4.4 mm. The paratype is smaller.

Distribution: Only known from the type locality.

Remarks: This species is different from other Caribbean species of Triphoridae because of its planktotrophic but short protoconch. The shell may have some similarity with the following:

Marshallora modesta and *M. nigrocincta* have larger shells, and both protoconchs are different (see Figs. 8G, 8H), with more whorls and with the upper spiral thread located above the middle of the whorl.

Marshallora nichupte and *"Triphora" calva* both have protoconchs that lack axial sculpture.

Cheirodonta apexcrassum (Rolán and Fernández-Garcés, 1994) has a protoconch with spiral cords but no axial ribs (Fig. 34J).

"Triphora" turtlebayensis spec. nov. Rolán and Lee (Figs. 29A-G)

Type material: Holotype (Figs. 29A, 29B) in FLMNH *ex* CHL. Paratypes: in BMSM (1 s, Figs. 29C, 29D), USNM (1 s) and CHL (3 s). All from the type locality. Other paratypes: 4 s, Bermuda (A. Haycock) (ANSP 105606).
Other material examined: 4 s eroded, Shelly Bay, Bermuda (ANSP 145963); 1 s eroded (labeled as *T. modesta*), (A. J. Peile) Bermuda (BMNH 1911.17.21.641-50).
Type locality: Off Turtle Bay, Bermuda.
Etymology: The specific name alludes to the name of the type locality.

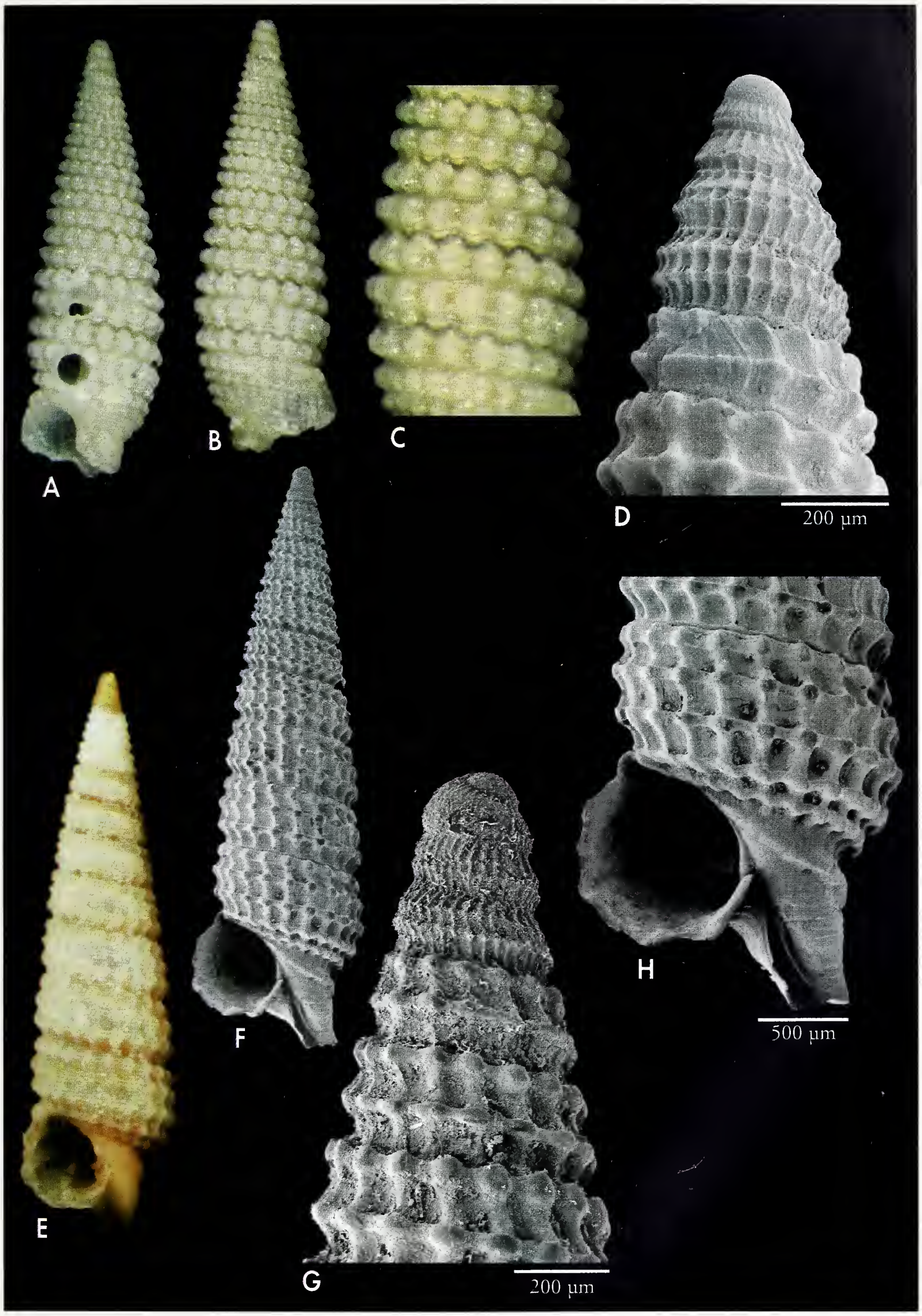

Figure 33. A-D. "*Triphora*" sp. 2. A, B: shell, 4.6 mm, La Herradura, N of Cuba (MHNS); C: detail of the spire; D: protoconch. E-H. "*Triphora*" sp. 3. E, F: shell, 5.8 mm, Miami, Florida (FLMNH); G: protoconch; H: detail of the aperture.
Figura 33. A-D. "Triphora" *sp. 2. A, B: concha, 4,6 mm, La Herradura, N de Cuba (MHNS); C: detalle de la espira; D: protoconcha. E-H.* "Triphora" *sp. 3. E, F: concha, 5,8 mm, Miami, Florida (FLMNH); G: protoconcha; H: detalle de la abertura.*

Description: Shell (Figs. 29A-29D) ovoid elongate, solid. Protoconch (Figs. 29E, 29F) paucispiral, with two whorls and a diameter of 300 µm on the first whorl and 380 on the second. The nucleus is smooth, the first whorl with prominent opisthocline axial ribs crossed at its end by 2 transient spiral cords; on the second whorl these two cords are well defined and the axial ribs change, becoming prosocline and more dense at the end. Spirals 1 and 3 are present at the beginning of the teleoconch, with the lower spiral more prominent. On the subsequent whorls they become more widely separated, and on about the fifth whorl spiral 2 appears between them. This smaller spiral increases in size on the two final whorls, but spiral 1 continues to have slightly larger nodules. Suture deep. Towards the base of the final whorl there are three additional spirals that are separated by numerous axial threads. Aperture ovoid (Fig. 29G), columella thickened at the base and outer lip extended, closing off the opening of the short, curved siphonal canal. The colour is uniformly light brown.

Dimensions: The holotype measures 4.1 mm. Paratypes of similar or smaller size.

Distribution: Only known from the type locality.

Remarks: The differences of this species with *"T." calva* are the following: *"T." turtlebayensis* has a wider shell, the protoconch is wider and has 2 whorls with prominent axial and spiral sculpture beginning on the first whorl, the siphonal canal is closed and there are numerous axial threads between the basal cords.

There are other Caribbean species with a similar shell but all of them have different protoconchs: *Cheirodonta apexcrassum* (Fig. 34J), *Sagenotriphora osclausum* (Fig. 22D-22F) and *Marshallora modesta* (Fig. 8G).

"Triphora" grenadensis spec. nov. Rolán and Lee (Figs. 30A-F)

Type material: Holotype (Figs. 30A-30D) in ANSP (313668).
Type locality: Levera Beach, N end of Grenada (R.A. and V.O. Maes, 1966), on *Caulerpa*, 1-3 m.

Description: Shell (Figs. 30A-30D) dark brown, somewhat darker on the suture, relatively solid, pointed. Protoconch (Figs. 30E, 30F) paucispiral, with a little more that 2 whorls and a diameter of about 300 µm, the apex smooth, the first protoconch whorl with a poorly defined wide spiral cord just below the periphery, crossed by rather well separated axial ribs, opisthocline above the spiral and prosocline below, forming an angle in the middle. On the subsequent whorl the spiral cord is well defined and above it the axial ribs are almost orthocline. Teleoconch with seven whorls with two spiral beaded cords (spiral 1 and 3) on the first four whorls; on the fifth, spiral 2 appears between the other two but is smaller, the three spirals being similar in size on the final whorls. The aperture is rectangular, the siphonal canal short and open; the border of the outer lip is white.

Dimensions: The holotype measures 3.2 mm.

Distribution: Only known from the type locality.

Renarks: This species is described and named in spite of the scarcity of the study material, due to the fact that it has very distinct differences with all other Caribbean species, probably being endemic to Grenada.

Comparison must be made with the species that have a similar shell and protoconch:

"T." calva has a similar shell, but the protoconch is always smooth, lacking any axial sculpture except for a spiral elevation on the second whorl.

"T." turtlebayensis has a similar protoconch but it is light brown in colour, with two spiral cords located on the upper middle of the whorl. Furthermore the shell is a little more slender, of a uniform light brown

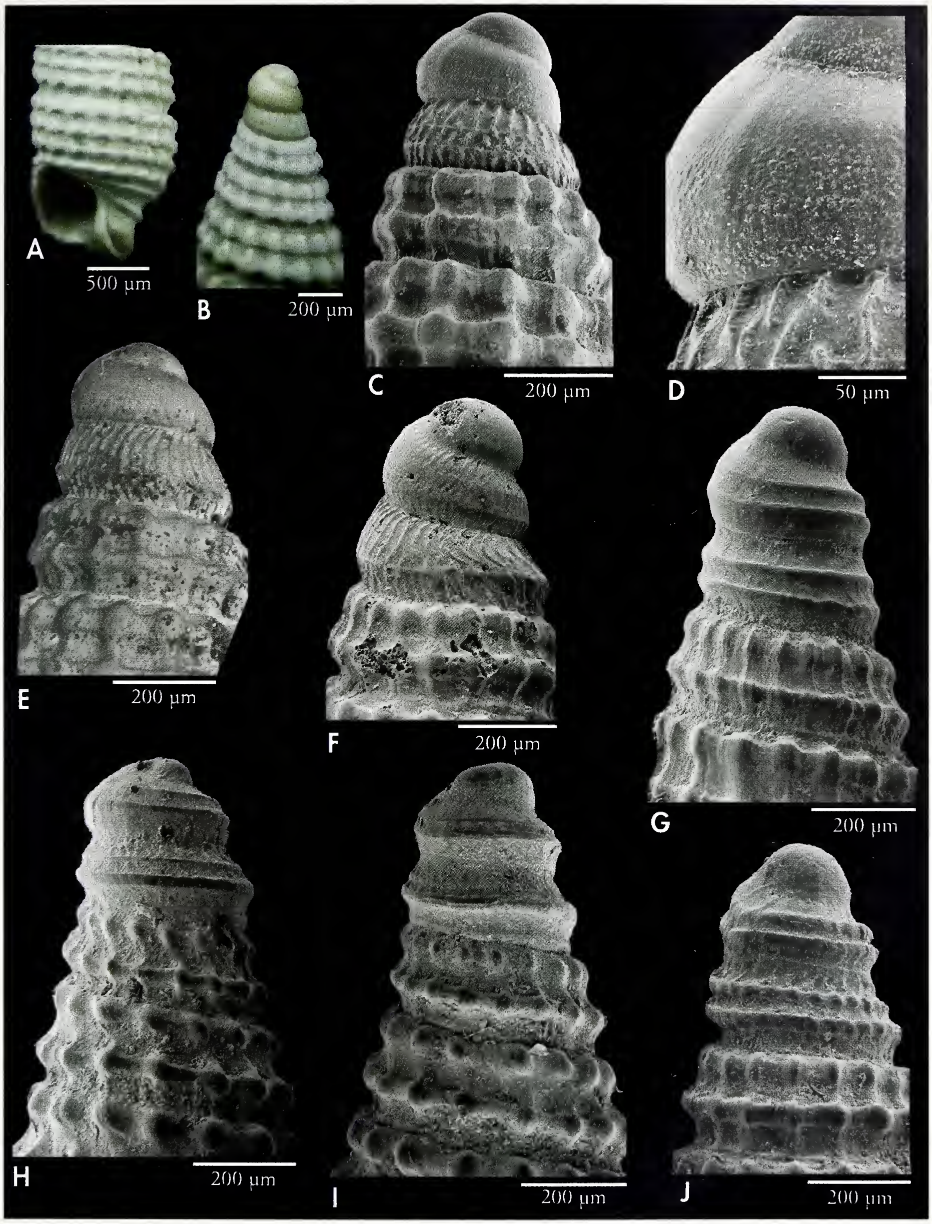

Figure 34. A-D. "*Triphora*" sp. 4. Batabano, Cuba (MHNS); A: fragment; B: protoconch; C: protoconch, SEM photograph; D: detail of the sculpture of the protoconch. E, F. "*Triphora*" sp. 5. Protoconchs, Cienfuegos, Cuba (MHNS). G. "*Triphora*" sp. 6. Protoconch, Cienfuegos, Cuba (MHNS). H. "*Triphora*" sp. 7. Protoconch, Miskito Archipelago, Nicaragua (MHNS). I. "*Triphora*" sp. 8. Witties Cape, Nicaragua (MHNS). J. *Cheirodonta apexcrassum*, Cuba (MHNS).
Figura 34. A-D. "Triphora" *sp. 4. Batabanó, Cuba (MHNS); A: fragmento; B: protoconcha; C: protoconcha, fotografía al MEB; D: detalle de la escultura de la protoconcha. E, F.* "Triphora" *sp. 5. Protoconchas, Cienfuegos, Cuba (MHNS). G.* "Triphora" *sp. 6. Protoconcha, Cienfuegos, Cuba (MHNS). H.* "Triphora" *sp. 7. Protoconcha, Archipiélago Miskito, Nicaragua (MHNS). I.* "Triphora" *sp. 8. Cabo Witties, Nicaragua (MHNS). J.* Cheirodonta apexcrassum, *Cuba (MHNS).*

colour, the aperture is rounded with an occlusion of the base of the siphonal canal and lacks white colour on the outer lip.

Other species with a similar shell but different protoconch are mentioned in the *Remarks* for *"T." turtlebayensis*. The comparison is valid for this species.

"Triphora" abacoensis spec. nov. Rolán and Redfern (Figs. 31A-G)

"Triphora" sp. A. Redfern, 2001. *Bahamian Seashells*, p. 69, figs. 289A, 289B.

Type material: Holotype (Figs. 31A, 31B) in BMSM (15499); paratypes; 1 j (Fig. 31C) beach drift, Treasure Cove 26° 42′ 00″N, 77° 18′ 30″W, (CCR); 1 j (Figs 31E, 31G) Chub Rocks 26° 43′ 55″N, 77° 13′ 05″W 10 m (CCR), 1 j (Fig. 31D) from the type locality (MHNS); 1 s, 3 j from the type locality (CCR); all of the above from Abaco, Bahamas. 1 paratype, Lucayan Waterway, off South End, Grand Bahama Island, Bahamas 26° 31′ 45″N, 78° 32′ 45″W (J. Worsfold) (ANSP 369222).
Other material studied: 2 j, Cienfuegos, Cuba 30 m (CFG and MHNS).
Type locality: East of Chub Rocks, Abaco, Bahamas in 52 m, 26° 44′ 00″N 77° 09′ 00″W.
Etymology: The specific name refers to Abaco, the island in the Bahamas from which the holotype was collected.

Description: See REDFERN (2001). Shell (Figs. 31A-31C) ovoid elongate, brownish, solid. Protoconch (Figs. 31D-31F) very distinctive, brown with a darker suture, the nucleus almost vertical and about 125 µm high, with a diameter of 250 µm; in total, the protoconch has a little more than 2 whorls; the surface of the tip is irregularly roughened but without tubercles; very strong prosocline axial ribs appear immediately below the nucleus and extend between the sutures to cover the entire whorl; minute, irregular spiral lines are visible under high magnification (Fig. 31G). Spirals 1 and 3 are present at the beginning of the teleoconch, their nodules connected by axial ribs; spiral 2 appears on the third whorl, with all spirals being of similar size. The colour is brown, with spiral 1 darker. The aperture is not known, as the shells studied are juveniles. Siphonal canal short.

Dimensions: The holotype, which is juvenile, measures 2.5 mm.

Distribution: Known from the Bahama Islands. One of the protoconchs collected in Cuba (Fig. 31F), in spite of being narrower, is probably of the same species.

Remarks: The type material consists of immature shells, but the protoconch is so characteristic that it was finally decided to describe the species and to give it a name, as there is none similar in the studied area.

There are no species in the Caribbean having this kind of protoconch with strongly prosocline axial ribs.

"Triphora" portoricensis spec. nov. Rolán and Redfern (Figs. 32A-E)

Iniforis sp. Redfern, 2001. *Bahamian Seashells*, p. 66, figs. 278A, 278B.

Type material: Holotype (Figs. 32A, 32B) (FLMNH UF363895). One paratype (Fig. 32D), f, east of Chub Rocks, Abaco, Bahamas, 26° 44′ 00″N, 77° 09′ 00″W 52 m (CCR).
Type locality: Puerto Rico.
Etymology: The name derives from Puerto Rico, the island on which the holotype was found.

Description: Shell (Figs. 32A, 32B) conical elongate, light brown, with the apex white. The protoconch (Fig. 32C) has about 2 $^{3}/_{4}$ whorls and has a prominent keel a little below the middle of the whorl. Above and below this keel there

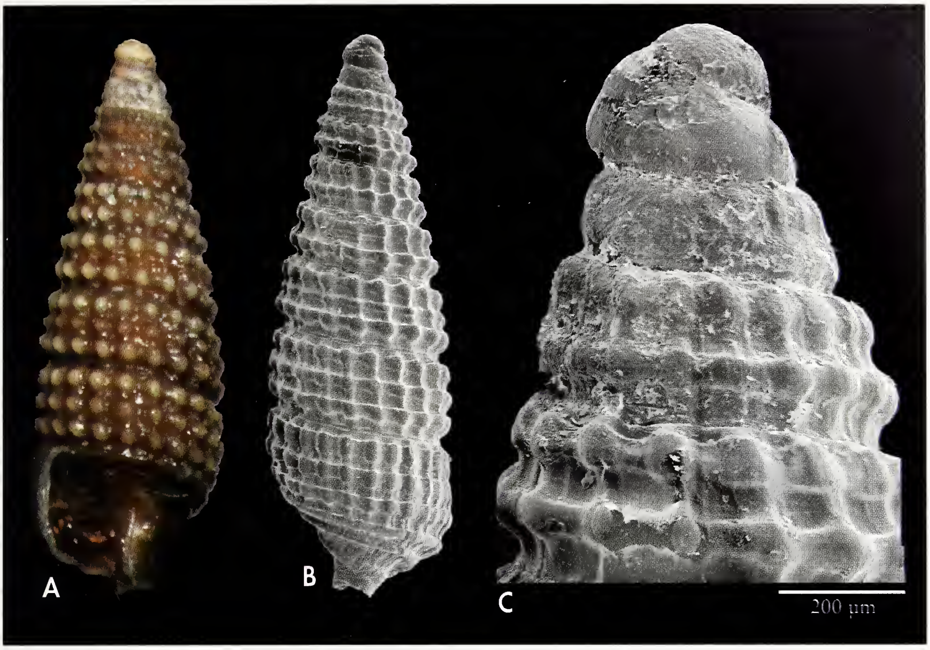

Figure 35. "*Triphora*" sp. 9. Key Matias, Los Canarreos Archipelago. S Cuba (MHNS).
Figura 35. "Triphora" *sp. 9. Cayo Matías, Archipiélago de Los Canarreos. S Cuba (MHNS).*

are narrow axial ribs, orthocline at the beginning and slightly prosocline below. The teleoconch has about 8 whorls, with spirals 1 and 3 present at the beginning and spiral 2 appearing on the third whorl, smaller initially but immediately enlarging until it is the same size as the other two. On the last whorls, the three spirals are similar but the lowermost is more prominent, and a very small, smooth spiral appears just on the suture. On the base this spiral 4 is wider, and three more smooth spiral cords appear below. The aperture is ovoid, the outer lip sharp, the columella curved, the siphonal canal short and open.

Dimensions: The holotype measures 4.4 mm. The paratype is a juvenile.

Distribution: Only known from Puerto Rico and the Bahamas.

Remarks: The paratype from the Bahamas (Figs. 32D, 32E) differs slightly from the holotype; for example the spiral cord on the protoconch is more prominent and, on the teleoconch, spiral 2 appears a little earlier, but these are small differences, while the others characters are similar. For this reason both are considered to be the same species.

The protoconch of this species is somewhat similar to those of some species in the genus *Iniforis*, such as *Iniforis immaculata* Rolán and Fernández-Garcés, 1993 and *I. carmelae* Rolán and Fernández-Garcés, 1993, but those two species are white and always have only two spirals throughout the teleoconch, with large nodules; that is very different from the three spirals and small nodules on most of the teleoconch of *"T." portoricensis*.

No other Caribbean species has this kind of protoconch. The most similar are those with a short protoconch that has one spiral: *"T." turtlebayensis* spec. nov. and *"T." grenadensis* spec. nov., but they have differences on the teleoconch and also on the protoconch, where the axial sculpture is present from the beginning and crosses the spiral cord.

"*Triphora*" sp. 1 (Figs. 30G-I)

Material studied: British Honduras (now Belize): 2 s (Figs. 30G, 30H), Cangrejo Bay, 17° 51′ 35″N, 88° 02′ 55″W (R. Robertson, July 1961) (ANSP 282402).

Description: Shell (Figs. 30G, 30H) elongate, narrow, solid and brown in colour. Protoconch (Fig. 30I) paucispiral, with only two whorls, the upper one apparently smooth, followed by another whorl on which there are two very fine spiral threads. The teleoconch begins with spirals 1 and 3, which both have nodules connected by orthocline axial ribs. About the fifth whorl, spiral 2 appears between spirals 1 and 3, starting very narrow but increasing in size on the following whorls; on the body whorl the size of the three spirals is similar. On the lower part of the whorls, very close to the suture, a very small, smooth spiral can be seen. On the base, this spiral is wider and below it there are two more, the lowermost close to the siphonal canal.

Dimensions: The studied shells measure 3.5 mm.

Remarks: "*T.*" *calva* has a wider shell, the protoconch with only one cord on the second whorl.

"*T.*" *turtlebayensis* spec. nov. and "*T.*" *grenadensis* spec. nov. have axial ribs on the protoconch.

"*T.*" *yociusi* spec. nov. has a shell with bands of colour; the protoconch is wider and has only 1 3/4 whorls.

This species is undoubtedly a valid endemic from Belize, but only two shells have been studied, one of them with the protoconch somewhat eroded, the other decollated and in not very good condition. It is therefore preferable to keep this species without a name, waiting for more material in the future.

"*Triphora*" sp. 2 (Figs. 33A-D)

Material examined: 1 s and 1 protoconch. La Herradura, N of Cuba (MHNS).

Description: Shell (Figs. 33A, 33B) cream, solid, ovoid elongate.

The apex of the protoconch is broken, with the remaining three whorls showing only one spiral cord. The protoconch (Fig. 33D) of a juvenile presumed to be the same species has 4 whorls, the apex with microscopic tubercles and the following whorls with one thread crossed by slightly opisthocline axial ribs; on the subsequent whorls there are two spiral threads. However, the protoconch of the complete shell, although slightly eroded, differs by having only one spiral cord.

Teleoconch with nine whorls beginning with two nodulous cords, the nodules being large and spherical; on about the seventh whorl a narrow spiral thread appears between the other two, located very close to spiral 1 and therefore very undulating (Fig. 33C); it enlarges very slowly and only becomes nodulous on the final whorl, the nodules being smaller that those on spiral 1; the nodules on spiral 3 decrease in size on the final whorl; on the base there are 4 more smooth cords. Aperture rounded. Siphonal canal short and open.

The colour is very characteristic: uniform cream with only a small brown spot between each nodule.

Dimensions: The shell studied measures 4.6 mm.

Remarks: The characters are very typical and different from any other species in the Caribbean. But only one shell was found, and there is not even any certainty that the protoconch is from the same species, so the species will not be named until more material has been obtained.

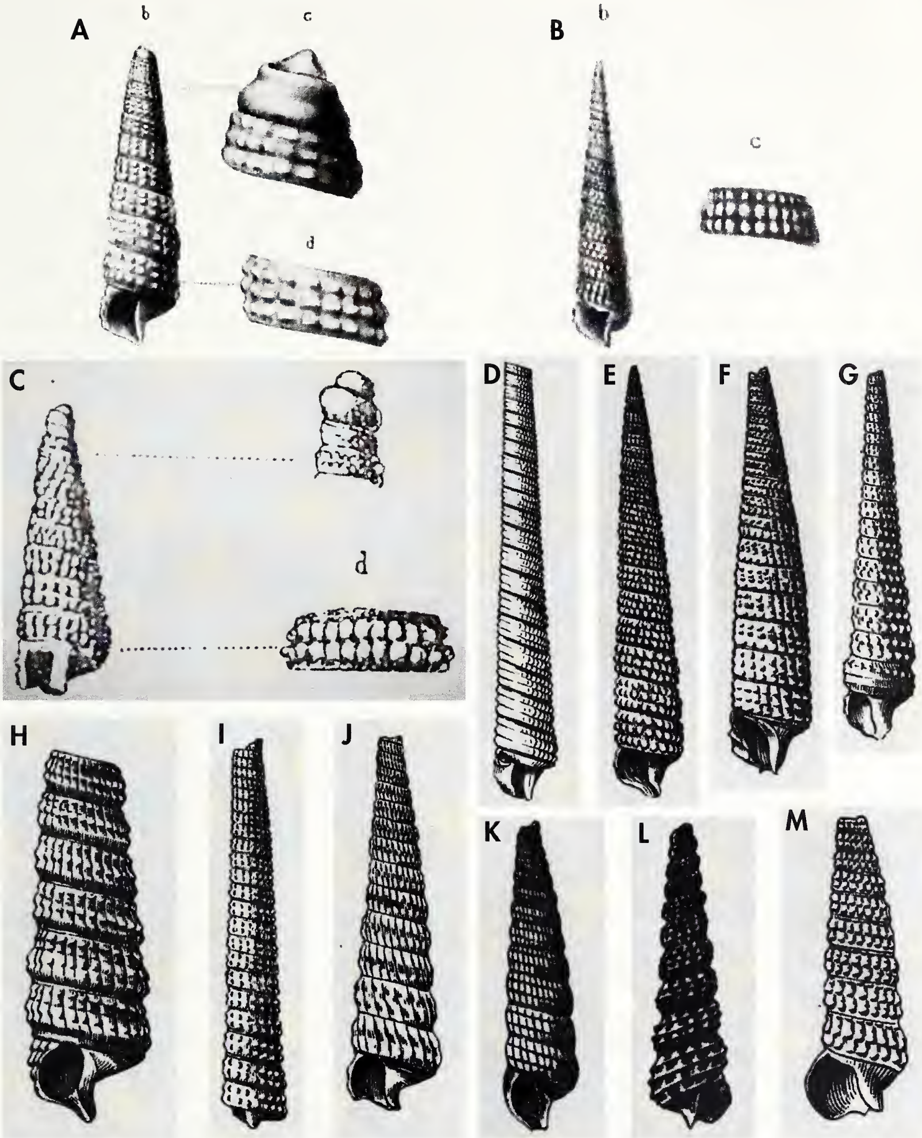

Figure 36. Original drawings of some triphorids. A: *Triforis hebes* (from WATSON, 1886); B: *Triforis bigemma* (from WATSON, 1886); C: *Triforis inflata* (from WATSON, 1886); D: *Triforis longissima* (from DALL, 1889); E: *Triforis triserialis* (from DALL, 1889); F: *Triforis intermedia* (from DALL, 1889); G: *Triforis inflata* Watson var. *ibex* (from DALL, 1889); H: *Triforis torticula* (from DALL, 1889); I: *Triforis colon* (from DALL, 1889); J: *Triforis bigemma* var. *hircus* (from DALL, 1889); K: *Triforis cylindrella* (from DALL, 1889); L: *Cerithiopsis abrupta* (in DALL, 1889 not Watson); M: *Triforis abrupta* (from DALL, 1889).

Figura 36. Dibujos original de algunos trifóridos. A: Triforis hebes *(en WATSON, 1886); B:* Triforis bigemma *(en WATSON, 1886); C:* Triforis inflata *(en WATSON, 1886); D:* Triforis longissima *(en DALL, 1889); E:* Triforis triserialis *(en DALL, 1889); F:* Triforis intermedia *(en DALL, 1889); G:* Triforis inflata *Watson var. ibex (en DALL, 1889); H:* Triforis torticula *(en DALL, 1889); I:* Triforis colon *(en DALL, 1889); J:* Triforis bigemma *var.* hircus *(en DALL, 1889); K:* Triforis cylindrella *(en DALL, 1889); L:* Cerithiopsis abrupta *(en DALL, 1889 non Watson); M:* Triforis abrupta *(en DALL, 1889).*

"Triphora" sp. 3 (Figs. 33E-H)

Material examined: 1 s, 5.8 mm Miami, Florida (FLMNH UF363887).

Description: Shell (Figs. 33E, 33F) large, cream coloured, darker at the suture and on the base. Protoconch (Fig. 33G) with three whorls, apex tuberculated, subsequently with 2 spiral threads crossed by numerous axial ribs. Teleoconch with spirals 1 and 3 at the beginning, spiral 2 appearing on about the fourth whorl; the spiral cords and the axial ribs are relatively narrow, forming prominent nodules at the points of intersection. Two beaded cords appear on the base, with another smooth one below on the dorsum of the siphonal canal. Aperture (Fig. 33H) rounded, the outer lip a little everted and sharp; an extension of the lip crosses the columella, closing the beginning of the siphonal canal. The siphon is relatively larger than in most of the Caribbean species and is initially wider.

Remarks: The present shell is very different from any other studied from the Caribbean. With three protoconch whorls it is assumed to have planktotrophic development, and therefore it is strange that no other example of this species has appeared in the large quantity of material studied. This suggests that the shell may have incorrect collection data, and hence it has not received a name and awaits more information in the future.

Some similarity may be observed with *"T." auffenbergi*, but the shell of that species is larger, has more whorls and a more uniform color, the protoconch is narrower at the apex and the siphonal canal is larger.

"Triphora" sp. 4 (Figs. 34A-D)

Material studied: Cuba: 10 f (Figs 34A-34D), Cienfuegos, Jibacoa and Batabanó (CFG).

Description: Shell whitish, elongate, pupoid. Protoconch (Fig. 34C) with two whorls, light brown in colour, with a diameter of 235 µm and with a microsculpture of small irregular tubercles (Fig. 34D) on the first whorl, while on the second there are two spiral threads crossed by poorly defined axial ribs. The teleoconch begins immediately with two spiral cords crossed by orthocline axial ribs; on the subsequent whorls spiral 2 appears, on the last whorl becoming of similar size to the other spirals.

Distribution: The material studied consists only of fragments from several localities from the south of Cuba, and as the material is not fresh, it is possible that it could be from Quaternary deposits.

Remarks: No material good enough for a correct description of this species was collected.

Several characters differentiate this species from most of the Caribbean triphorids, such as having a short protoconch with small tubercles, and only fine sculpture on the rest of the protoconch.

"T." *calva* has a protoconch wider than the present species, lacking any microsculpture of tubercles or axial threads.

"T." *grenadensis* spec. nov. and "T." *turtlebayensis* spec. nov. have protoconchs with stronger axial sculpture that begins at the apex.

"T." *amicorum* spec. nov. has a protoconch with more than 2 whorls and stronger spiral sculpture.

Triphora sp. 5 (Figs. 34E, F)

Material studied: 2 j, Cienfuegos, Cuba.

Description: The protoconchs (Figs. 34E, 34F) of the two shells of this species have between 2 and 2 $^1/_2$ whorls, the first one with a diameter of about 222

μm and the second about 250 μm; the nucleus is smooth (if not eroded), and there are numerous opisthocline axial ribs on the first whorl, crossed by two weak spiral cords that combine into one on the second whorl.

Remarks: This kind of protoconch suggests a planktotrophic development, but with a shorter period of planktotrophy than the other species. It can be differentiated from the previous species (Triphora sp. 4) which has no thread on the first whorl and two small ones on the second protoconch whorl.

The most similar protoconchs are:

"*T.*" *calva* has a protoconch that lacks any axial sculpture.

"*T.*" *grenadensis* spec. nov. and "*T.*" *turtlebayensis* spec. nov. have protoconchs with stronger but less crowded axial sculpture.

"*T.*" *amicorum* spec. nov. has a protoconch with more than 2 whorls, less crowded axial sculpture and only one spiral cord.

"*Triphora*" sp. 6 (Fig. 34G)

Material examined: 1 f, Cienfuegos, Cuba.

Remarks: This protoconch (Fig. 34G) is slightly similar to that of *Cheirodonta apexcrassum* Rolán and Fernández-Garcés, 1994, but the latter has a protoconch with beaded cords (Fig. 36J), unlike those on this fragment.

"*Triphora*" sp. 7 (Fig. 34H)

Material studied: 1 fragment, Miskito Archipelago, Nicaragua (MHNS).

Remarks: This protoconch with only two whorls has two cords as on the previous one, but in this shell the whorls appear scratched, and the apex is more depressed.

"*Triphora*" sp. 8 (Fig. 34I)

Material studied: 1 f, Cabo Witties, Nicaragua (MHNS).

Remarks: This protoconch with only two whorls has two cords as on the previous one, but in this case the whorls have two very different spirals cords, the upper one being very weak and the lower one stronger.

"*Triphora*" sp. 9 (Figs. 35A-C)

Material studied: 1 s, Canarreos, Cuba (MHNS).

Remarks: This shell is dark brown, has spirals 1 and 3 at the beginning of the teleoconch; spiral 2 appears between whorls 4 and 5. Protoconch short with only 1 $^{1}/_{2}$ whorls, apparently smooth.

II. Erroneous records, invalid species or species not included in the study

"*Triphora*" *hebes* Watson, 1880 (Fig. 36A)

Triphora hebes Watson, 1880. *Moll. of the Challenger expedition*, 1886, p. 103; 1886, pl. 43, figs. 7a-d. [Type locality: Tristan de Cunha, 230 m].

Description: WATSON (1880).

Remarks: This species was recorded in the Caribbean by PILSBRY AND AGUAYO (1933), but the original description and figure of WATSON (1886) show a shell with an unusual, short protoconch of only one whorl and a pointed apex, which is different from any other species known in the area. Furthermore, the type locality is an island in the south Atlantic Ocean. This record must therefore be considered an error, confused with another species with paucispiral protoconch.

"Triphora" filata Dall, 1889

Triforis (Sychar) inflata var. *filata* Dall, 1889. *Bull. M. C. Z.*, 18: 249. [Type locality: Station 136, near Santa Cruz, 929 m].

Type material: No types in USNM (E. Strong, pers. comm.); it was not present in the material examined from other museums (ANSP, MCZ, etc.).

Remarks: This must be considered a *nomen nudum* because there is no description (DALL, 1889: 249) and it was only mentioned as a variety, without any explanation of the differences.

Triforis barbadensis Coomans and Faber, 1984

Triforis barbadensis Coomans and Faber, 1984. Bulletin Zoologisch Museum. *Studies on West Indian Marine Molluscs*, 2.

Remarks: The genus *Triforis* Deshayes, 1834, in spite of having been used for many of the shells described and discussed above, does not belong to the family Triphoridae, but to Cerithiopsidae. For this reason this species, although being valid and present in the study area, is not included in the family studied here.

CONCLUSIONS

Species in this work

From the 68 taxa studied in the present work, 30 were previously known, 26 are described as new and 12 were not named or received a tentative name due to the scarcity of study material or the existence of doubts about their determination. More than 3000 specimens and shells have been examined for the present work, of which more than 600 are included in the material examined for the species here included.

New species in the Caribbean

FABER AND MOOLENBEEK (1991), in their Remarks in the original description of *Triphora calva*, pointed out that "It is quite a surprise to find an undescribed species with such a characteristic shell in Florida". In the following years more than 10 species were described as new from the Caribbean, sometimes proving to be abundant in areas such as the Nichupté Lagoon in Quintana Roo, Yucatán; also to be considered are the numerous species described in the present work, as well as those awaiting more material before they can be fully described and named.

Total number of Caribbean species

The previous work (ROLÁN AND FERNÁNDEZ-GARCÉS, 2007) constituted a summary of several papers written in recent years concerning the species known from Cuba, with 33 species of Triphoridae figured in colour. The present work, complementary to that

paper, includes the study of 68 species, as well as 3 which are invalid taxa for the area or are not included in Triphoridae. Of those 68 species, only 2 (*Monophorus olivaceus* and *Sagenotriphora osclausum*) had been mentioned in previous works by these authors, and are now referred to with the addition of new information. Therefore the total number of species of this family in the study area (Caribbean and adjacent regions) exceeds one hundred, some of them unnamed due to the scarcity of available material and/or doubts about their determination.

State of the art of the study of this group in the Caribbean

In the last 30 years (1977 to the present work) 21 new species of triphorids have been described as new; 26 more are described and named in this work, and 12 more species await description in the future; a total of 59 species, which represents more than half of the estimated one hundred species in the area. All of which supports the observation already made in ROLÁN AND FERNÁNDEZ-GARCÉS (2007) that this group has not yet been completely studied, in spite of the fact that more than half of the valid species listed here were only described in the last 30 years.

Distribution range

An important number of the studied species are from deep water, and this makes it difficult to know exactly their distribution range, due to the limited number of samplings made and the shortage of available information in other studies. Undoubtedly some species do not have an extended range and are probably endemic to individual islands, due to their non-planktotrophic development.

Endemic species

Out of approximately a hundred species of Triphoridae known from the Caribbean and adjacent areas, about half have a protoconch of 3 whorls or less, which represents for many of these a short planktotrophic or non-planktotrophic larval development, and probably most of these are endemic to a small area. This suggests that more new species can probably be found in the future after some of the islands have been sampled in detail for the first time, thus increasing the total number of species.

Generic assignment

A significant part of the studied material consisted of dry shells collected by old expeditions, therefore no information on soft parts was available. Only in a few cases could the radula be studied from this dry material. For this reason many of the studied species were placed in *Inella* or in "*Triphora*" *sensu lato*, because the radula is very important for generic assignment. Future collecting expeditions will probably result in a complete revision of these species, at which time their correct generic assignment will be made.

Apart of "*Triphora* sensu lato", at least 15 genera are considered to be present in the Caribbean area: *Inella* (25 species, some of them whithout a definitive assignation), *Metaxia* (7), *Marshallora* (6), *Iniforis* (5), *Cheirodonta* (4), *Isotriphora* (3), *Cosmotriphora* (2), *Monophorus* (2), *Sagenotriphora* (2), *Aclophora* (1), *Eutriphora* (1), *Latitriphora* (1), *Mesophora* (1), *Nototriphora* (1), and *Similiphora* (1).

List of names for species of Triphoridae recorded from the Caribbean and adjacent areas

A list of taxa referred to the study area was presented in ROLÁN AND FERNÁNDEZ-GARCÉS (2007). Some changes were made in the present work and for this reason it is necessary to revise it. Hence, a new list is provided in Table I, including information on distribution, habitat, protoconch whorls and shell colour.

The list includes128 specific names, some of which are not currently considered to be triphorids; 94 are considered here as valid species (which with the addition of the 11 mentioned without name in the present work, raises the number of specific taxa mentioned to 105); 27 are probably synonyms or errors, and 8 are only known as fossils.

Table I. List of taxa employed for the Caribbean and adjacent areas, with taxonomic status, synonymy, and other information on the protoconch, range of distribution, depth and colour. Abbreviations, B: shell more or less uniformly brown; BB: shell with brown bands of different intensity; BW: shell brown with isolated white dots; BWB: shell brown and white, but without bands; V: shell of variable colour; W: shell white; WBB: shell white with brown bands; DW: deep water (more than 100 m); SW: shallow water; M: protoconch multispiral (3 whorls or more); P: protoconch paucispiral (less than 3 whorls); R: reduced distribution (few records from small area); U: poorly known because it is a deep water species; WI: wide distribution (several records).
Tabla I. Listado de taxones empleados para el Caribe in áreas adyacente, con su status taxonómico, sinominias e información sobre su protoconcha, distribución, profundidad y color. Abreviaturas, B: concha casi toda marrón; BB: concha con bandas marrones de distinta intensidad; BW: concha marrón con puntos blancos aislados; BWB: concha marrón y blanca, pero sin bandas; V: concha de color variable; W: concha blanca; WBB: concha blanca con bandas marrones; DW: aguas pofundas (más de 100 m); SW: aguas someras; M: protoconcha multiespiral (3 ó más vueltas); P: protoconcha pauciespiral (menos de 3 vueltas); R: distribución restringida (pocas citas en un área pequeña); U: escasamente conocida por ser especie de aguas profundas; WI: amplia distribución (varias citas).

Name of taxon	colour	depth	protoconch	range
abacoensis Rolán and Redfern spec. nov. "*Triphora*"	B	SW	P	R?
abrupta (Watson, 1880), *Metaxia* (error, not Caribbean)				
abrupta (Dall, 1881), "*Triphora*"	W	DW	?	U
affinis (Hinds, 1843), "*Triphora*" (nomen dubium)				
albida (A. Adams, 1854), *Latitriphora*	BWB	SW	M	WI
amicorum Rolán and Fernández-Garcés spec. nov. "*Triphora*"	BW	SW	P	?
angasi (Crosse and Fischer, 1865) "*Triphora*" (error)				
apexbilirata Rolán and Fernández-Garcés spec. nov. *Inella*	W	DW	M	R?
apexdiversus Rolán and Lee spec. nov. *Marshallora*	BWB	SW	M	?
apexcrassum Rolán and Fernández-Garcés, 1994, *Cheirodonta*	B	SW	P	R?
arnoldoi Faber and Moolenbeek, 1991, *Cosmotriphora*	BWB	SW	M	WI
aspera Jeffreys, 1885, *Strobiligera* (=*brychia*)				
ateralbus Rolán and Fernández-Garcés, 1994, *Monophorus*	BW	SW	M	R
auffenbergi Rolán and Lee spec. nov. "*Triphora*"	B	SW	M	?
barbadensis Coomans and Faber, 1984 *Triforis* (not Triphoridae)	B	DW	P	R
bartschi Olsson, 1916, "*Triphora*"	fossil	fossil	P	fossil
bermudensis (Bartsch, 1911), *Eutriphora*	WBB	SW	M	WI
bermudensis (Verril and Bush, 1900) *Metaxia* (=*rugulosa*?)				
bigemma (Watson, 1880), *Inella*	W	DW	?	U
bolax Olsson and Harbison, 1953, "*Triphora*"	fossil	fossil	?	fossil
brychia (Bouchet and Guillemot), 1978, *Strobiligera*	W	DW	M	WI
calva Faber and Moolenbeek, 1991, "*Triphora*"	B	SW	P	WI?
candidula Rolán and Lee spec. nov. *Sagenotriphora*	W	SW	M	?
caracca Dall, 1927, "*Triphora*"	W	DW	?	U
caribbeana Treece, 1980, "Triphora" (nomen nudum)				
carmelae Rolán and Fernández-Garcés, 1993, *Iniforis*	BWB	SW	P	S
casta (Hinds, 1843), *Iniforis*	WBB	SW	P	WI
clenchi Aguayo, 1935, "*Triphora*" (unnecessary new name)				
colon (Dall, 1881), "*Inella*"	W	DW	?	U
compsa Dall, 1927, "*Inella*"	W	DW	?	U
cylindrella (Dall, 1881), "*Triphora*"	W	DW	?	U
dealbata (C. B. Adams, 1850), "*Triphora*" (=*melanura*?)				
decollata Rolán and Fernández-Garcés, 1994, *Cheirodonta*	BW	SW	M	S
decorata (C. B. Adams, 1850), *Nototriphora*	BWB	SW	M	WI

Table I. Continuatión.
Tabla I. Continuación.

Name of taxon	colour	depth	protoconch	range
differens Rolán and Lee spec. nov. *Inella*	B	DW	P	U
dinea Dall, 1927, *"Inella"*	W	DW	P	U
distincta (Meyer, 1886), *"Triphora"*	fossil	fossil	?	fossil
dupliniana (Olsson, 1916), *"Triphora"*	fossil	fossil	?	fossil
ellyae De Jong and Coomans, 1988, *"Triphora"*	WBB	SW	M	WI
elvirae De Jong and Coomans, 1988, *"Triphora"*	WBB	SW	M	WI
enopla Dall, 1927, *"Inella"*	W	DW	P	U
espinosai Rolán and Fernández-Garcés, 1993, *Metaxia*	W	SW	P	S
excelsa Faber and Moolenbeek, 1991, *Metaxia*	B	SW	M	WI
exiguum (C. B. Adams, 1850), *Triphora*? (nomen dubium)				
exile C. B. Adams, 1850 non Eichholtz, 1829 (=*excelsa*)				
faberi Rolán and Fernández-Garcés spec. nov. *Inella*	B	SW	P	?
filata (Dall, 1889), *Strobiligera* (= *inflata*) *nom. nudum*				
gaesona Dall, 1927, *"Inella"*	W	DW	P	U
georgiana Dall, 1927, *"Triphora"*	W	DW	P	U
grenadensis Rolán and Lee spec. nov. *"Triphora"*	B	SW	P	R
guadalupensis Rolán and Fernández-Garcés spec. nov. *"Triphora"*	BB	SW	P	R
guanahacabibes Rolán and Fernández-Garcés spec. nov. *Isotriphora*	W	DW	P	R
guttata (Guppy, 1874), *"Triphora"*	fossil	fossil	?	fossil
harryleei Rolán and Fernández-Garcés n. sp. *Inella*	BWB	DW	P	U
hebes Watson, 1881 in Pilsbry and Aguayo, 1933 *Triphora*? (error, not Caribbean)				
hemphilli Bartsch, 1907, *"Triphora"* (error, not Caribbean)				
hircus (Dall, 1881), *"Triphora"*	W	DW	?	U
Ibex (Dall, 1881), *"Inella"*	W	DW	?	U
immaculata Rolán and Fernández-Garcés, 1993, *Iniforis*	W	SW	P	S
inaudita Rolán and Lee spec. nov. *"Triphora"*	WBB	DW?	M	?
indigena Dall, 1927, *"Triphora"*	W	DW	M	U
inflata (Watson, 1880), *Inella*	W	DW	P	U
intermedia (C. B. Adams, 1850), *Similiphora*	WBB	SW	M	WI
intermedia (Dall, 1881), *"Inella"*	W	DW	?	U
intermedius Tryon, 1887 non Adams *Triforis* (= *turristhomae)*				
lilacina Dall, 1889, *"Triphora"*	lilac	SW	?	?
cf. lilacina, "Triphora"	WBB	DW	M	U
longissima (Dall, 1881), *Inella*	W	DW	?	U
marmorata (Hinds, 1843), *"Triphora"* nomen dubium				
martii Rolán and Fernández-Garcés, 1995, *"Triphora"*	WBB	SW	M	S
medinae Parodiz, 1955 *"Triphora"* (error)				
melanura (C. B. Adams, 1850), *Cosmotriphora*	W	SW	M	WI
metaxa (delle Chiaje, 1828), *Metaxia* (error; not Caribbean)				
meteora Dall, 1927, *"Inella"*	W	DW	P	U
mirabile (C. B. Adams, 1850), *Iniforis* (= *turristhomae*)				
mitella Dall, 1892, *"Triphora"*	fossil	fossil	?	fossil
miskitorum Rolán and Luque, 1999, *Cheirodonta*	W	SW	P	S
modesta (C. B. Adams, 1850), *Marshallora*	B	SW	M	WI
Nana (C. B. Adams, 1850) *"Triphora"* nomem dubium				
nicaraguensis Rolán and Luque, 1999, *Marshallora*	B	SW	P	S
nichupte Rolán and Cruz-Ábrego, 1996, *Marshallora*	V	SW	P	S
nigrocincta (C. B. Adams, 1839), *Marshallora*	B	SW	M	WI

Table I. Continuatión.
Tabla I. Continuación.

Name of taxon	colour	depth	protoconch	range
noduloides Rolán and Fernández-Garcés spec. nov. *Inella*	W	DW	P	R
novem (Nowell-Usticke, 1969), *Mesophora*	BB	SW	M	WI
olivaceus (Dall, 1889), *Monophorus*	BWB	SW	M	WI
oreodoxa Olsson and Harbison, 1953, "*Triphora*"	fossil	fossil	?	fossil
ornata (Deshayes, 1832), "*Triphora*" (error; not Caribbean)				
ornatus auct. non Deshayes, 1832, *Monophorus* (=*olivaceus*)				
orteai Espinosa, 2001 "*Triphora*" (= *ellyae*)				
osclausum (Rolán and Fernández-Garcés, 1995) *Sagenotriphora*	B	SW	M	WI
ostenta Rolán and Fernández-Garcés spec. nov. *Marshallora*	WBB	SW	M	WI
peetersae (Moolenbeek and Faber, 1989), *Isotriphora*	BB	SW	P	WI
perversa Linné in Dall, 1889 (error, not Caribbean)				
pfeifferi (Crosse and Fischer, 1865) "*Triphora*" (error)				
pinarena Espinosa, Ortea and Fernández-Garcés, 2007, *Inella*	BWB	SW	M	R?
portoricensis Rolán and Redfern spec. nov. "*Triphora*"	B	SW	P	R
pompona Dall, 1927, "*Inella*"	W	DW	P	U
prompta Rolán and Fernández-Garcés spec. nov. *Metaxia*	V	?	P	?
propria Rolán and Fernández-Garcés spec. nov. *Metaxia*	W	DW	P	U
propinqua Rolán and Fernández-Garcés spec. nov. *Metaxia*	V	SW	P	U
pseudolongissima Rolán and Fernández-Garcés spec. nov., *Inella*	W	DW	M	U
pseudonovem Rolán and Fernández-Garcés spec. nov. "*Triphora*"	B	?	M	?
pseudothomae Rolán and Fernández-Garcés, 1993, *Iniforis*	WBB	SW	M	WI
pseudotorticula Rolán and Lee spec. nov. *Inella*	BWB	DW	P	U
pulchellum C. B. Adams, 1850 "*Triphora*" (= *intermedia*)				
pusilla (Pfeiffer, 1840), "*Triphora*" nomen dubium				
pyrrha (Henderson and Bartsch, 1914), "*Triphora*"	B?	?	M	?
rugulosa (C. B. Adams, 1850), *Metaxia*	W	SW	M	WI
rushii Dall, 1881, "*Triphora*"	W	DW	?	U
sagei Rolán and Fernández-Garcés, 1995, *Aclophora*	BB	SW	M	WI
samanae (Dall, 1889), *Latitriphora* (= *albida*)				
sarissa Dall, 1889, "*Inella*"	W	DW	?	U
sentoma Dall, 1927, "*Inella*"	W	DW	?	U
slapcinskyi Rolán and Fernández-Garcés spec. nov. *Inella*	W	SW	P	?
somersi Peile, 1926 "*Triphora*" nomem dubium				
somersi Pilsbry and Aguayo, 1933 "*Triphora*" nomen nudum				
taenialba Rolán and Espinosa, 1994, *Isotriphora*	BB	SW	P	R
taeniolata (Dall, 1889), *Metaxia*	WBB	SW	M	WI
terebrata (Heilprin, 1889) "*Triphora*"	fossil	fossil	?	fossil
Torticula (Dall, 1881), "*Inella*"	W	DW	?	U
triserialis (Dall, 1881), "*Inella*"	W	DW	P	U
turrissimilis (Nowell-Usticke, 1969), *Iniforis* (= *bermudensis*)				
turristhomae (Holten, 1802), *Iniforis*	WBB	SW	M	WI
turtlebayensis Rolán and Lee spec. nov. "*Triphora*"	B	?	P	R
undebermuda Rolán and Lee spec. nov. *Inella*	W	DW	P	U
variegata (A. Adams, 1854), "*Triphora*" (= *decorata*)				
vestalis (A. Adams, 1854) 1851? *Triphoris* (error: it is a *Cerithiopsis*)				
verbernei (Moolenbeek and Faber, 1989), *Cheirodonta*	BW	SW	M	WI
vicina (C. B. Adams, 1850), *Metaxia* (= *rugulosa*)				
yociusi Rolán and Lee spec. nov. "*Triphora*"	B	DW	P	R

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Sinonimias
Doris limbata Cuvier, 1804, *Ann. Mus. H. N. Paris*, 4 (24): 468-469 [Localidad tipo: Marsella].
Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop. Car.*, 10: 275.

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Ponder, W. F., 1988. The Truncatelloidean (= Rissoacean) radiation - a preliminary phylogeny. In Ponder, W. F. (Ed.): Prosobranch Phylogeny, *Malacological Review*, suppl. 4: 129-166.

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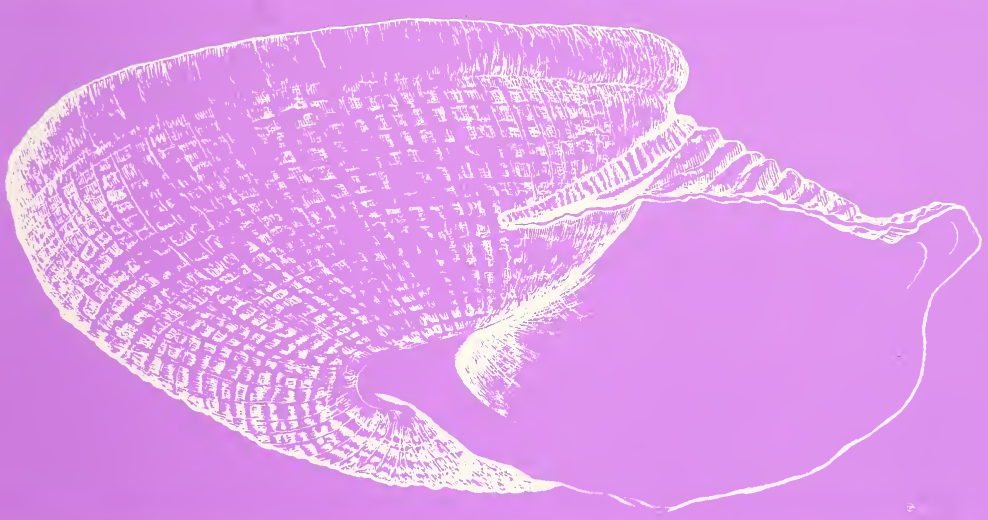

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Ultrastructural studies on the spermatogenesis of the African mussel *Perna perna* (Bivalvia: Mytilidae)

Estudio ultraestructural de la espermatogénesis del mejillón africano *Perna perna* (Bivalvia: Mytilidae)

Soumya BENOMAR*, Oumkeltoum BELHSEN**, Didier GOUX**, Michel MATHIEU** and Abdellatif MOUKRIM*[1]

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ABSTRACT

Transmission electron microscopy of spermiogenesis in gonads of *Perna perna* (Mytilidae) was carried out to study the different developmental stages and the structure of mature sperm. Samples of mussels originated from a population living at Cap Ghir (southwestern Morocco) and were collected from December 1999 to June 2000 at several periods of their sexual cycle. Numerous acini, surrounded by a connective tissue containing vesicular cells, constituted the male gonad of *P. perna*. Groups of spermatogonia, spermatocytes, and spermatids, interconnected by intercellular bridges, were found in these acini. Proacrosomal vesicles and a short flagellum developed early in spermatogonia. Numerous Sertoli-like cells were distributed among spermatogonia, nearest the inner wall of each acinus. The reduced cytoplasm of primary and secondary spermatocytes mainly contained mitochondria and proacrosomal vesicles. Spermatogenesis consisted of a progressive condensation of the chromatin and a reduction in size of the nucleus, the migration of the proacrosomal granule from the base of the nucleus to its apex to become the acrosome, and the elaboration of the flagellum by the distal centriole. The nucleus of the mature spermatozoon was barrel shaped and contained a completely condensed chromatin. The funnel shaped acrosome showed two types of electron-dense materials in the basal and apical parts, and a more lucent zone in the subacrosomal invagination and the center of the premembranoid sleeve. An axial rod could be observed from the apex of the acrosome up to the base of the nucleus. The length of the nucleus in the spermatozoon, the premembranoid sleeve, and the presence of three types of materials in the acrosome might be additional criteria to separate the Moroccan populations of *P. perna* from other Mytilidae and, in particular, from those of *Mytilus galloprovincialis* which also lives along Moroccan coasts.

RESUMEN

Las gónadas de *Perna perna* (Mytilidae) se examinaron en microscopía electrónica de transmisión (TEM) con el fin de estudiar los estadios de desarrollo y la estructura del esperma maduro. Las muestras de mejillones se originaron de una población asentada en Cap Ghir (suroeste de Marruecos) y fueron colectadas entre diciembre de 1999 y junio de 2000 en varios momentos de su ciclo sexual. La gónada macho de *P. perna* se compone de numerosos ácinos, rodeados por un tejido conectivo que contiene células vesicu-

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losas. Grupos de espermatogonias, espermatocitos y espermatidias, vinculados por puentes intercelulares, fueron encontrados en estos ácinos. Vesículas proacrosomales y un flagelo corto se desarrollaron temprano en las espermatogonias. Numerosas células tipo Sertoli estaban distribuidas en las espermatogonias, junto a la pared interna de cada ácino. El citoplasma reducido de espermatocitos primarios y secundarios contenía principalmente mitocondrias y vesículas proacrosómicas. La espermiogénesis consistió en una progresiva condensación de la cromatina y reducción del tamaño del núcleo, en la migración del gránulo proacrosomal desde la base del núcleo hasta su ápice en donde forma el acrosoma y en la elaboración del flagelo por el centriolo distal. El núcleo del espermatozoo maduro tiene forma de barril y contiene una cromatina completamente condensada. El acrosoma, en forma de embudo, presenta dos tipos de materiales densos frente a los electrones de las partes basal y apical y una zona más clara en la invaginación subacrosomal y en el centro de la manga premembranóide. Una varilla axial se puede observar entre el ápice del acrosoma y la base del núcleo. La longitud del núcleo del espermatozoo, la manga premembraníode y la presencia de tres tipos de material en el acrosoma pueden resultar criterios adicionales para diferenciar las poblaciones marroquíes de *P. perna* de otros Mytilidae y particularmente de aquellas de *Mytilus galloprovincialis*, que también vive en la costa marroquí.

KEY WORDS: *Perna perna*, spermatogenesis, *Mytilidae*, ultrastructure.
PALABRAS CLAVE: *Perna perna*, espermatogénesis, *Mytilidae*, ultraestructura.

INTRODUCTION

In Bivalvia, the morphology of the spermatozoon gives information on the mode of fertilization (in water, or in the mollusc) (Franzen, 1955) and on the systematic position of taxa (Healy, Keys and Daddow, 2000). As the morphology of this gamete is well conserved in several taxa, it is considered to be a good indicator of phylogenetic relationships between species, in particular when these come close to each other (Popham, 1979; Healy *et al.*, 2000). A good example is the family Mytilidae, as the characteristics of the spermatozoon vary remarkably between genera (Kafanov and Drozdov, 1998).

Contrary to studies which have been carried out on the spermatogenesis of numerous mytilids, little information on the developmental cell stages of the male line in *Perna perna* is available in literature. The fine structure of mature spermatozoa of this mussel was already studied by Bourcart, Lavallard and Lubet (1965), or by Bernard and Hodgson (1985), while aspects of spermiogenesis in *P. perna* were first described by Bernard and Hodgson (1985). By contrast, to our knowledge, there are no published reports on the first cell stages of spermatogenesis. Therefore, the aim of this work was to describe the fine structure of the developmental cell stages which succeeded in the spermatogenesis of this mussel and, in particular, during the formation of the acrosome, as this organelle has a direct implication on the fertilization of the oocyte.

As other populations of *P. perna* live worldwide under tropical conditions (see the review by Hicks, McMahon and Ingrao, 2001), it is interesting to detect the variations which may exist in the morphology of spermatozoa when they originate from different communities of mussels, as the fine structure of these male cells has already been studied in Brazilian (Bourcart *et al.*, 1965) as well as in South African (Bernard and Hodgson, 1985) populations of *P. perna*. Consequently, the second aim of this work was to compare spermatozoon morphologies between

the abovementioned populations of *P. perna* and the Moroccan mussels, as *P. perna* is present here at the northern limit of its distribution along the Atlantic coasts of Africa.

Finally, as the Moroccan mussels are abundantly consumed by local people, a project to develop the breeding of this mollusc for commercial purposes has been set up in Morocco (BERRAHO, 1998). However, to realize this project, more detailed information on the local reproduction of *P. perna* was necessary. Several studies of our team were already carried out on the growth, ecology, reproduction, and reserve strategy of this species (ID HALLA, BOUHAIMI, ZEKHNINI, NARBONNE, MATHIEU AND MOUKRIM, 1997; NAJIMI, BOUHAIMI, DAUBEZE, ZEKHNINI, PELLERIN, NARBONNE AND MOUKRIM, 1997; KAAYA, NAJIMI, RIBERA, NARBONNE AND MOUKRIM, 1999; MOUKRIM, KAAYA, NAJIMI, ROMÉO AND GNASSIA-BARELLI, 2000). The work reported in the present study completes these first papers and gives information on the development of the male line in this mussel.

MATERIALS AND METHODS

Samples of five male mussels each (3-4 cm long, 8-9 g in weight) were collected in December 1999, January, March, June, and July 2000 from the mid-tide level at Cap Ghir (50 km north from Agadir town). The choice of these months for mussel sampling was based on the different sexual stages observed by ID HALLA *ET AL.* (1997) in the same population of *P. perna*: December (II stage), January (IIIA stage), March (IIIB and IIIC stages), June (IIIC and IIID stages), and July (IIIC and IIID stages). Small portions of male gonad (1-3 mm^3 each) were fixed for 60 min in 2% glutaraldehyde (in 0.4 M sodium cacodylate buffer, pH 7.2) at 4°C. The tissue was then washed in 0.4 M cacodylate buffer (3 x 10 min) and postfixed for 90 min in 1% tetroxide osmium (in 0.4 M cacodylate buffer) at 4°C. After dehydration through a gradual ethanol series, the tissues were directly embedded in Epon resin at 37°C for 60 min and were subsequently placed at room temperature during 12 hours for polymerization. Semi-thin sections of each gonad portion were stained at room temperature with 0.5% toluidine blue in 2.5% Na_2CO_3. Ultrathin sections were collected on copper grids and were stained for 20 min with uranyl acetate, followed by lead citrate for 5 min. Sections were examined using a Siemens 102 electron microscope.

The length and the width of each cell stage were also measured (10 cells at least per stage). Individual values recorded for each measurement and each cell stage were averaged.

RESULTS

Each gonad was constituted by many acini, surrounded by connective tissue and an external ciliated epithelium (Fig. 1A). From the internal wall of each acinus to the lumen, all developmental stages were present (Fig. 1B). Groups of spermatogonia are positioned nearest the wall of each acinus, groups of spermatocytes and spermatids were located closer to the acinus lumen, whereas the flagella of mature sperm were confined to the central lumen (Fig. 1B). All acini emptyed into spermatic ducts, each being lined by an internal ciliated, columnar epithelium. Vesicular cells, containing two types of granules, were distributed within the interacinar connective tissue (Fig. 1A).

Spermatogonia: Two types of spermatogonia (Fig. 2 A,B) were observed in the gonad of *P. perna*. The A spermatogonia (primordial cells) were large cells (16.6 x 5.9 μm in size). Their nucleus was often ovoid (6.3 x 4.0 μm), each with a single 1.6-μm nucleolus, and their translucent cytoplasm contained an extensive rough endoplasmic reticulum (RER), numerous mitochondria, and a Golgi apparatus. B spermatogonia are smaller cells (7.2 x 3.0 μm) and their nuclei (4.2 x 2.3 μm) had a well-developed euchromatin and sometimes a

visible nucleolus. Their dark cytoplasm contained numerous mitochondria, RER cisternae, and proacrosomal vesicles derived from the Golgi complex. These B spermatogonia had an irregularly-shaped membrane and intercellular bridges were frequently observed. In some B cells, a short flagellum elaborated by the distal centriole, at the base of the nucleus, could be seen. When the nuclei of B cells underwent metaphase (Fig. 3A), these spermatogonia became smaller (4.6 x 4.1 μm). Numerous Sertoli-like cells were distributed among spermatogonia, nearest the wall of each acinus. Each of these elongated (10.5 x 3.0 μm) and regularly-shaped cells contained an ovoid nucleus with chromatin condensed along the nuclear envelope. Numerous cytoplasmic processes in contact with close spermatogonia could be observed. The cytoplasm of these Sertoli-like cells contained numerous electron-dense inclusions, mitochondria, several lipid inclusions, and myelin-like figures (Fig. 2 A,B, and Fig. 3A).

Spermatocytes: The primary spermatocytes (Fig. 3B, C) were arranged in groups of 2-4 cells each, with intercellular bridges. When these cells were in prophase (pachytene stage), their nuclei were similar in shape to those of B spermatogonia. However, their nuclear envelope was thicker, with a clearly wider perinuclear cisterna. The small size (6.7 x 3.8 μm) of their cytoplasm increased the nucleo-cytoplasmic ratio. These cells contained the same organelles as described for B spermatogonia. A short flagellum was often observed (Fig. 3B, C).

The secondary spermatocytes were scarcely visible, due to the rapidity of the second meiotic division. These cells were irregular in shape (5.7 x 4.3 μm) and their rounded nuclei (a mean of 3.3-3.4 μm in diameter) contained chromatin forming a dense network at metaphase stage. Mitochondria and proacrosomal vesicles were mainly present in their reduced cytoplasm (Fig. 3D).

Spermatids: Their development within the gonad can be arbitrarily divided into four stages, from A the youngest, to D the oldest. A spermatids (Fig. 4A) were irregular in shape (7.4 x 6.6 μm) and their round nuclei (4 μm) contained scattered heterochromatin. Grouped mitochondria and proacrosomal vesicles close to the Golgi apparatus could be seen in their cytoplasm. B spermatids (Fig. 4B) were smaller (4.1 x 3.2 μm) than A cells and their nuclei were more reduced (2.5 x 1.9 μm), eccentrically positioned, and contained a more condensed heterochromatin. A proacrosomal granule, resulting from the fusion of the corresponding vesicles, was present in their cytoplasm. In C spermatids (Fig. 4C), the nuclei became rounded (2.2 x 1.9 μm) and the nuclear chromatin was continuously condensing, thus showing a patchwork pattern. The proacrosomal granule migrated from the basal part of the nucleus to the cell apex and progressively modified its shape. Its basal part, towards the nucleus, became flattened, whereas an invagination in the granule formed the subacrosomal zone, containing a material less electron-dense than that observed in the granule. Spherical mitochondria set up at the base of the nucleus and surrounded the centrioles. The nuclei of the oldest spermatids (Fig. 4D) became elongated, were completely condensed, and showed two invaginations, the first at the apex of the nucleus and the second at its base near the distal centriole. The proacrosomal granule progressively became funnel-like and turned into an acrosome containing a dense material. In several spermatids, a premembranoid sleeve was sometimes observed in the apical part of the acrosome. The flagellum showed gradual structural changes during the differentiation of spermatids. It is elaborated by the distal centriole and was surrounded by a ring of five mitochondria at the base of the nucleus. The distal and proximal centrioles were situated in perpendicular position (Fig. 4D).

Spermatozoa: In the 5.3 μm long head, the nucleus (1.35 μm in size) was barrel-like and was completely condensed. The very long acrosome was funnel-like

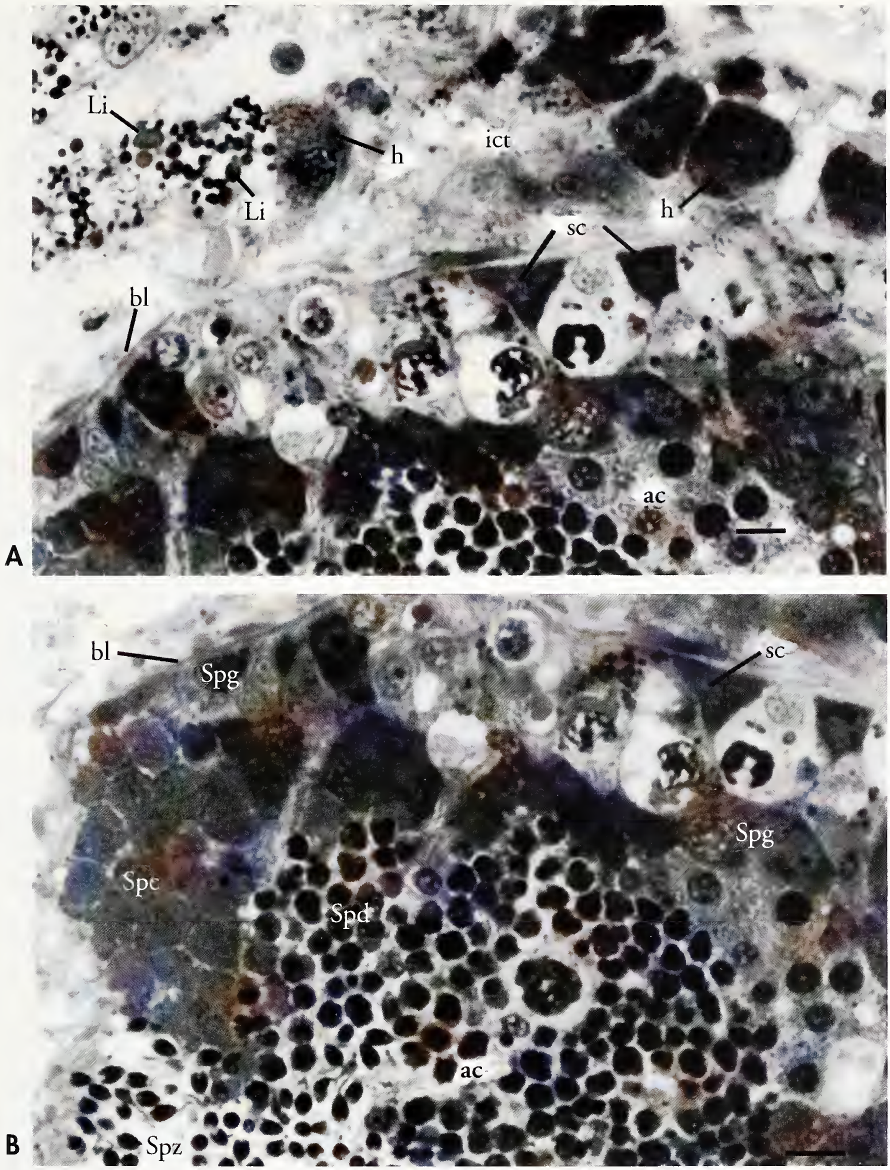


Figure 1. The male acini of *Perna perna*. A: semi-thin section showing vesicular cells in the interacinar connective tissue. These cells had two types of granules and lipid inclusions. B: semi-thin section of an acinus limited by a basal lamina. Sertoli-like cells and spermatogonia are located along its inner side. Abbreviations, ac: acinus; bl: basal lamina; h: hemocytes; ict: interacinar connective tissue; Li: lipid inclusions; sc: Sertoli-like cells; Spc: spermatocytes; Spd: spermatids; Spg: spermatogonia; Spz: spermatozoa; vc: vesicular cells. Scale bars, 10 µm.

Figura 1. Los ácinos macho de Perna perna. *A: sección semifina mostrando células vesiculares en el tejido conectivo entre ácinos. Estas células tenían dos tipos de gránulos y inclusiones de lípidos. B: sección semifina de un ácino limitado por una lámina basal. Células tipo Sertoli y espermatogonias están situados en su lado interno. Abreviaturas, ac: ácino; bl: lamina basal; h: hemocitos; ict: tejido conectivo interacinar; Li: inclusiones de lípidos; sc: células tipo Sertoli; Spc: espermatocitos; Spd: espermatidias; Spg: espermatogonia; Spz: espermatozoos; vc: células vesiculares. Escalas, 10 µm.*

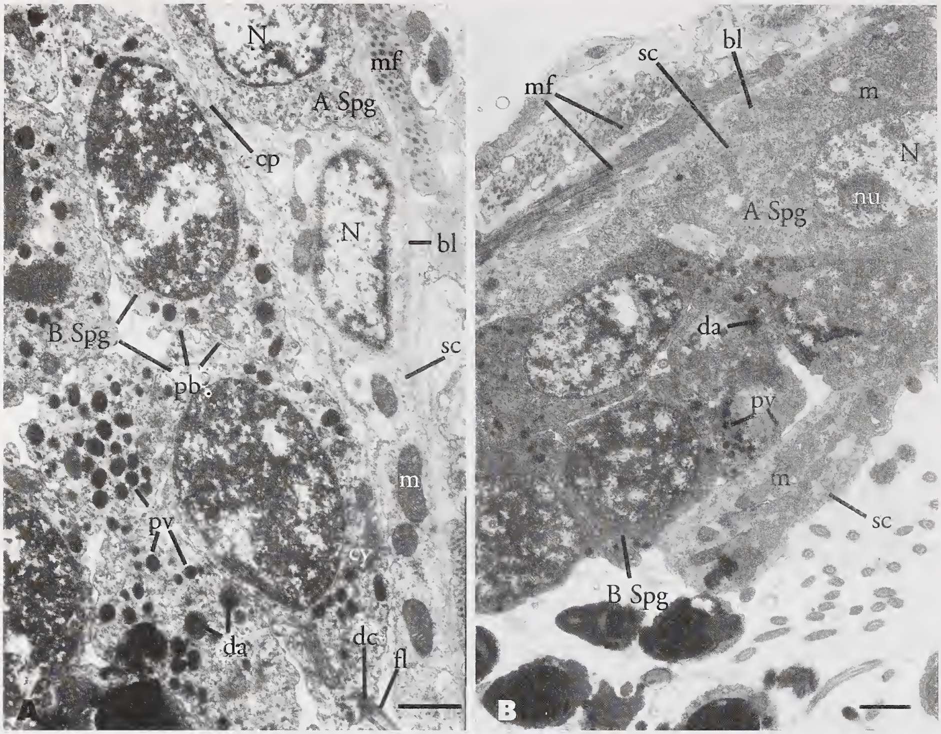
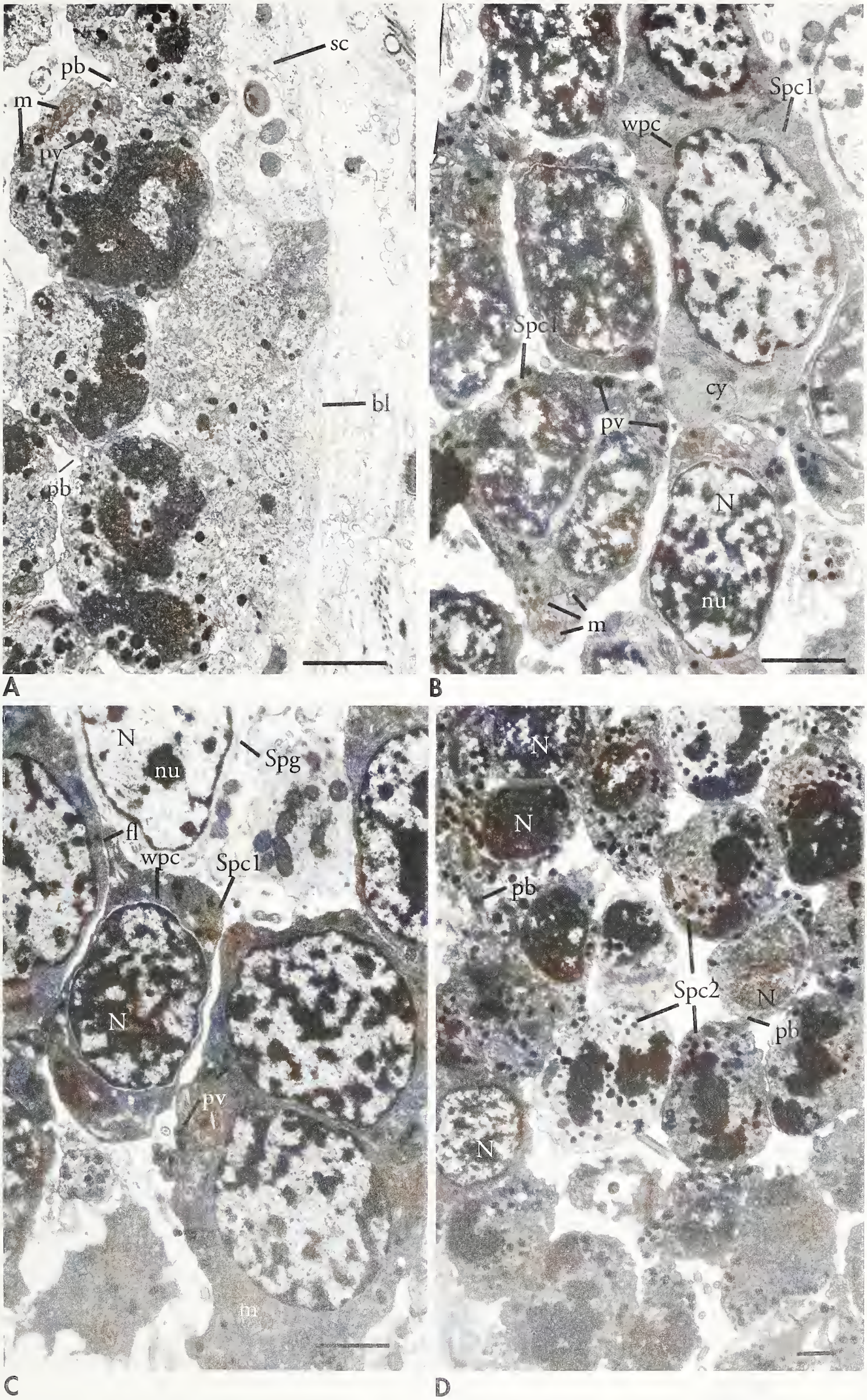


Figure 2. Ultrathin sections of early (A Spg) and late (B Spg) spermatogonia in *Perna perna*, separated from each other by cytoplasmic processes of Sertoli-like cells. Intercellular bridges between spermatogonia are frequent. Abbreviations: bl: basal lamina; cp: cytoplasmic processes of Sertoli-like cells; cy: cytoplasm; da: dense aggregates; dc: distal centrioles; fl: flagellum; m: mitochondria; mf: muscular fibers around the acinus; N: nucleus; nu: nucleolus; pb: intercellular bridges between spermatogonia; pv: proacrosomal vesicle; sc: Sertoli-like cells; Spg: spermatogonia. Scale bars, 5 µm.
Figura 2. Secciones ultrafinas de espermatogonias tempranas (A Spg) y tardías (B Spg) en Perna perna, *separadas unas de otras por extensiones citoplásmicas de células tipo Sertoli. Son frecuentes los puentes intercelulares entre espermatogonias. Abreviaturas: bl: lamina basal ; cp: extensiones citoplásmicas de células tipo Sertoli; cy: citoplasma; da: agregados densos; dc: centriolos distales; fl: flagelo; m: mitocondria; mf: fibras musculares rodeando el ácino; N: núcleo; nu: nucleolo; pb: puentes intercelulares entre espermatogonias; pv: vesícula proacrosomal; sc: células tipo Sertoli; Spg: espermatogonia. Escalas, 5 µm.*

(Right page) Figure 3. Ultrathin sections of spermatogonia and spermatocytes in *Perna perna*. A: B spermatogonia in metaphase. B, C: primary spermatocytes (Spc1) in prophase (pachytene stage), each showing a wide perinuclear cisterna. D: secondary spermatocytes (Spc2). Abbreviations, bl: basal lamina; cy: cytoplasm; fl: flagellum; m: mitochondria; N: nucleus; nu: nucleolus; pb: intercellular bridges between spermatogonia; pv: proacrosomal vesicle; sc: Sertoli-like cells; Spg: spermatogonia; wpc: wide perinuclear cisterna. Scale bar, 5 µm.
(Página derecha) Figura 3. Secciones ultrafinas de espermatogonias y espermatocitos de Perna perna. *A: espermatogonias B en metafase. B, C: espermatocitos primarios (Spc1) en profase (estadio paquiteno), cada uno mostrando una amplia cisterna perinuclear. D: espermatocitos secundarios (Spc2). Abreviaturas, bl: lámina basal ; cy: citoplasma; fl: flagelo; m: mitocondria; N: núcleo; nu: nucleolo; pb: puentes intercelulares entre espermatogonias; pv: vesícula proacrosomal; sc: células tipo Sertoli; Spg: espermatogonia; wpc: cisterna perinuclear ancha. Escalas, 5 µm.*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shaped, could reach up to 3.4 μm in length, and contained an axial rod from the apex to its basal part. Three types of material could be observed. An electron-lucent zone in the subacrosomal invagination and the center of the premembranoid sleeve could be observed, whereas two types of electron-dense materials were respectively present at the periphery of the apical part and in the base of the acrosome, the former material being denser than the latter. The axial rod passed outside the nucleus, from the apical to the posterior invaginations (Fig. 5A). At the base of the nucleus, five spherical mitochondria, of variable size (0.5-0.7 μm), surrounded the diplosome and constituted the middle piece (Fig. 5B). The two centrioles were situated in a perpendicular position and showed the classic nine triplets of microtubules (Fig. 5B). Some fibers, originating from the distal centriole and situated in a radiating position around it, formed a basal plate with the plasma membrane. Transversal sections of the axonemal complex of the flagellum (0.3 μm in diameter) showed the typical presence of 9 doublets along the periphery and a single central doublet. In this last zone, the cytoplasm was strongly reduced, thus increasing the nucleo-cytoplasmic ratio.

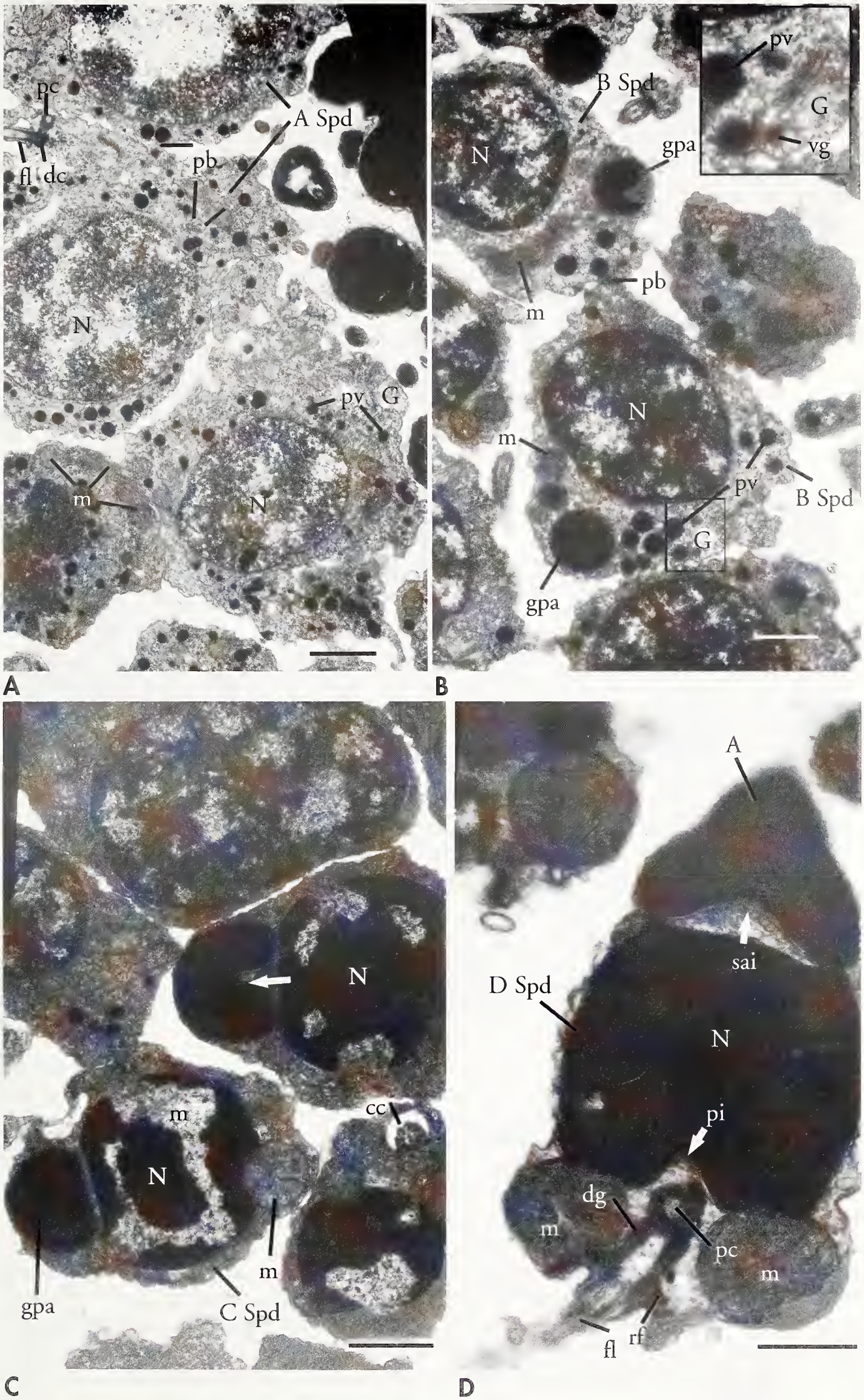
Abnormal spermatogenesis: Giant spermatogonia, each containing 2 to 5 nuclei (Fig. 6A), and binucleated spermatocytes were often found in December and March, respectively. In spermatids, lysis could affect the cytoplasm or the nucleus to finally yield to an extremely condensed nucleus or a thick nuclear envelope, respectively. At the end of spermatogenesis, the acrosome might lose its shape, curve, and even empty its material, thus giving an electron-lucent zone (Fig. 6B). Close to these abnormal cells, cytoplasmic inclusions with lipid inclusions and lysosomal membranes might be seen in the lumina of acini.

DISCUSSION

Most results on the spermatogenesis of *P. perna* are similar to those noted on the differentiation of male cells in other

(Right page) Figure 4. Ultrathin sections of spermiogenesis in *Perna perna*. A: a young spermatid (A Spd), with fusion of mitochondria and a Golgi complex showing synthetic activity. B: a proacrosomal granule and proacrosomal vesicles near the Golgi complex in an older spermatid (B Spd). C: a C spermatid (C Spd) with its nucleus showing a patchwork aspect. The proacrosomal granule is migrating to the anterior apex of the spermatid. D: an oldest spermatid (D Spd) showing the total condensation of the nucleus. The acrosome is at the cell apex. Abbreviations, A: acrosome; cc: centriolar complex; dc: distal centriole attached to the flagellum; fl: flagellum; G: Golgi complex; gpa: proacrosomal granule; ln: nuclear lacuna composed of heterochromatin; m: mitochondria; N: nucleus; pb: intercellular bridges; pc: proximal centriole; pi (white arrow): posterior invagination of the nucleus; pv: proacrosomal vesicles; rf: radiating fibers; sai (white arrow head): subacrosomal invagination of the nucleus; vg: Golgian vesicle. Scale bars, A-C: 2 μm; D: 1 μm.

(Página derecha) Figura 4. Secciones ultrafinas de espermiogénesis en Perna perna. *A: una espermatidia joven (A Spd), con fusión de mitocondrias y un complejo de Golgi mostrando actividad sintética. B: un gránulo proacrosomal y vesículas proacrosomales cerca del complejo de Golgi en una espermatidia más avanzada (B Spd). C: una espermatidia C (C Spd) cuyo núcleo muestra un aspecto en mosaico. El gránulo proacrosomal esta migrando hacia el ápice anterior de la espermatidia. D: una espermatidia de mayor edad (D Spd) mostrando la condensación total del núcleo. El acrosoma se sitúa en el ápice de la célula. Abreviaciones, A: acrosoma; cc: complejo del centriolo; dc: centriolo distal sujeto al flagelo; fl: flagelo; G: complejo de Golgi; gpa: gránulo proacrosomal ; ln: laguna nuclear compuesta por heterocromatina; m: mitocondria; N: núcleo; pb: puentes intercelulares; pc: centriolo proximal; pi (flecha blanca): invaginación posterior del núcleo; pv: vesículas proacrosomales; rf: fibras radiales; sai (cabeza de flecha blanca): invaginación subacrosomal del núcleo; vg: vesícula de Golgi. Escalas, A-C: 2 μm; D: 1 μm.*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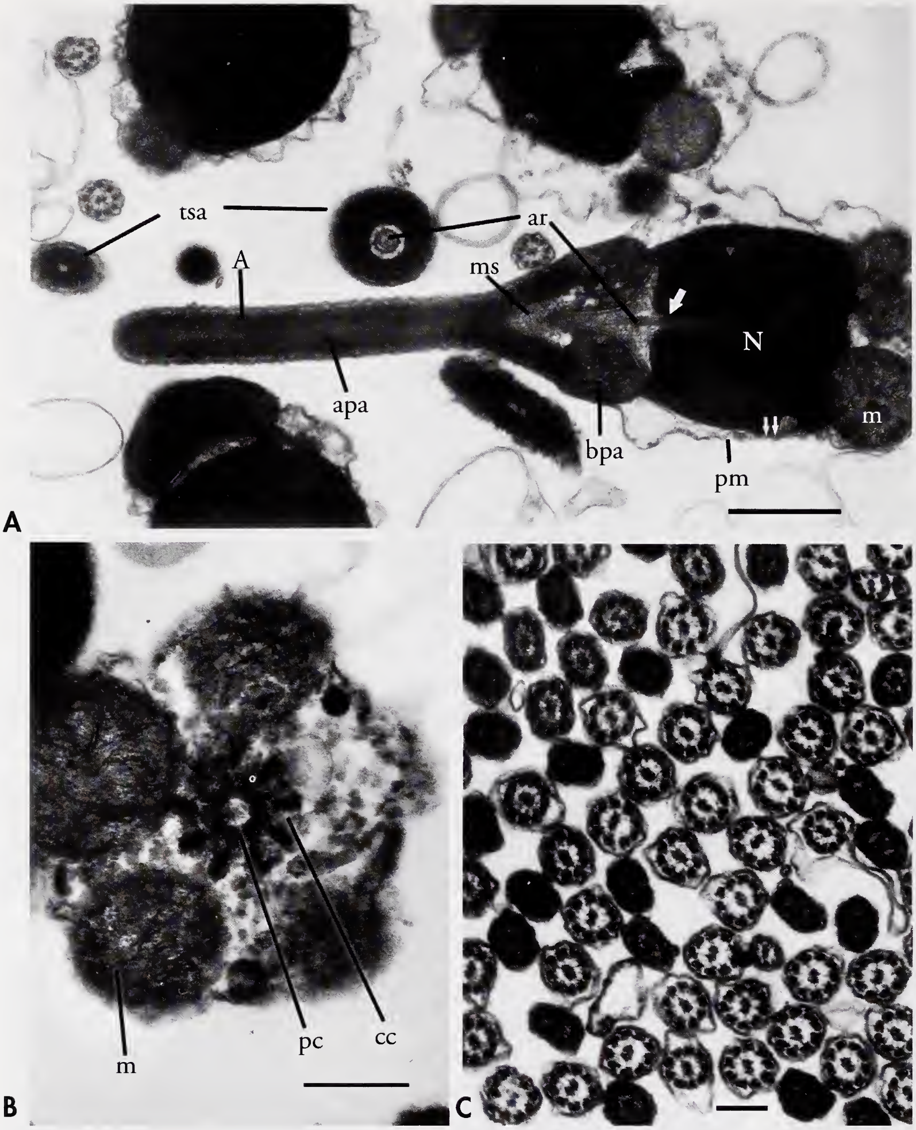

Figure 5. Mature spermatozoa (Spz) of *Perna perna*. A: longitudinal section, showing the barrel-like shaped nucleus and a greatly reduced cytoplasm (double white arrow). B: sagittal section of middle piece, showing five spherical mitochondria around the diplosome. C: transversal sections of flagella with nine peripheral doublets and a single central doublet of microtubules. Abbreviations, A: acrosome; apa: apical part of the acrosome; ar (white arrow): axial rod; bpa: basal part of the acrosome; cc: centriolar complex; m: mitochondria; ms: pre-membranoid sleeve; N: nucleus; pc: proximal centriole; pm: plasma membrane; tsa: transversal section of the acrosome. Scale bars, A, B: 2 µm; C: 0.5 µm.
Figura 5. Espermatozoos maduros (Spz) de Perna perna. *A: sección longitudinal, mostrando el núcleo en forma de barril y un citoplasma considerablemente reducido (doble flecha blanca). B: sección sagital de la parte mediana, mostrando cinco mitocondrias esféricas alrededor del diplosoma. C: secciones transversales de flagelos con nueve dobletes periféricos y un solo doblete cetral de microtúbulos. Abreviaturas, A: acrosoma; apa: parte apical del acrosoma; ar (flecha blanca): varilla axial; bpa: parte basal del acrosoma; cc: complejo del centriolo; m: mitocondria; ms: manga pre-membranóide; N: núcleo; pc: centriolo proximal; pm: membrana plasmática; tsa: sección transversal del acrosome. Escalas, A, B: 2 µm; C: 0,5 µm.*

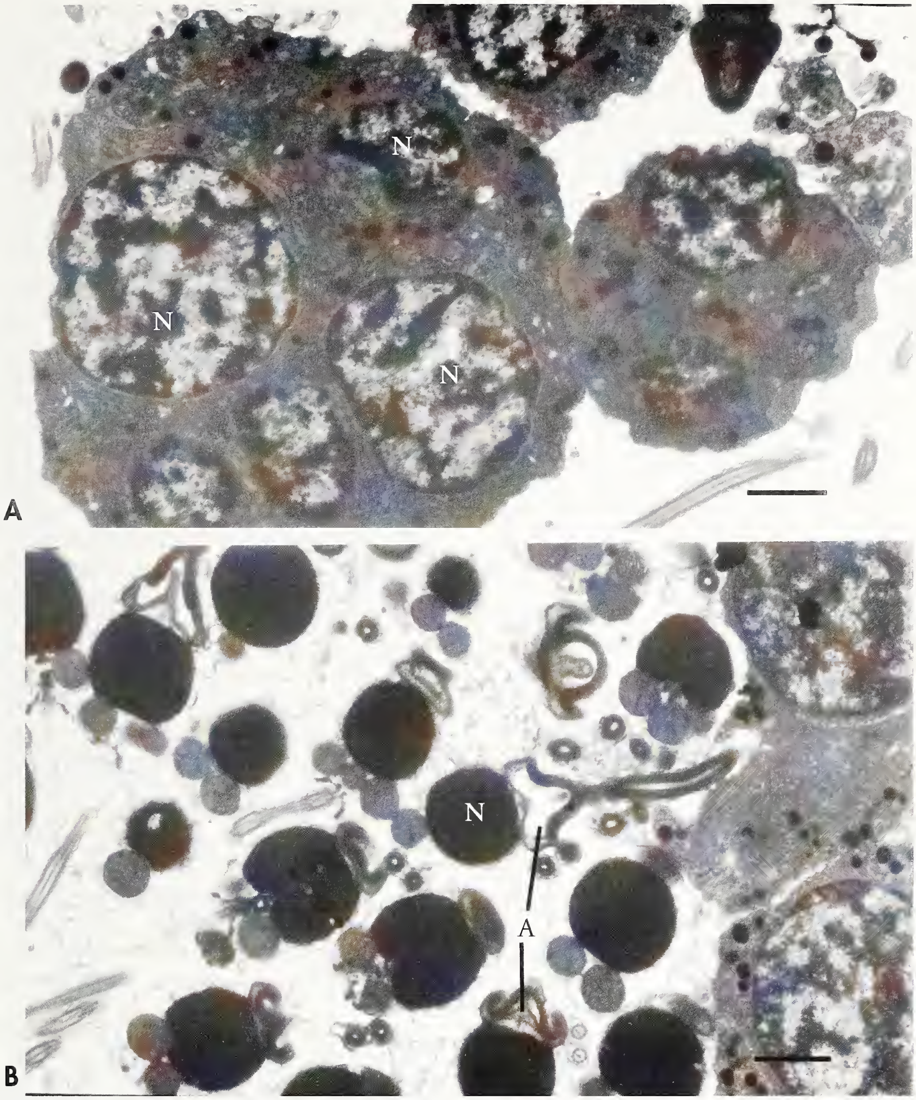

Figure 6. Abnormal spermatogenesis in *Perna perna*. A: a giant multinucleated spermatogonium. (B): acrosomal distortion, with emptying (black arrow) of the material (*). Abbreviations, A: acrosome; N: nucleus. Scale bars. 3 µm.

Figura 6. Espermatogenesis anómala en Perna perna. *A: una espermatogonia gigante multinucleada. B: distorsión acrosomal con escurrimiento (flecha negra) del material (*). Abreviaciones, A: acrosoma, N: núcleos. Escalas, 3 µm.*

bivalvia (LONGO AND DORNFELD, 1967; BERNARD AND HODGSON, 1985; HODGSON AND BERNARD, 1986A; REUNOV AND HODGSON, 1994; HEALY, 1996). All these reports demonstrated the existence of primitive spermatozoa (FRANZEN, 1955) in bivalvia. These primitive spermatozoa, also called aquasperm (ROUSE AND JAMIESON, 1987), are typical of invertebrate species which release their sperm in water. However, several points warrant special comments.

The barrel-like shape of the nucleus in the *P. perna* spermatozoon agreed with the report by BOUCART *ET AL.* (1965) on Brazilian *P. perna*, that of GARRIDO AND GALLARDO (1996) on *Perumytilus purpuratus*, or those of HODGSON AND BERNARD (1986a, b) and LONGO AND DORNFELD (1967) on *Mytilus edulis*. However, this shape was not the same for spermatozoa of other mytilid species (HODGSON AND BERNARD, 1986a, b; GARRIDO AND GALLARDO, 1996) and this discordance could be easily explained by the observations by POPHAM (1979). According to this author, in bivalvia, the shape of the sperm nuclei shows great variation in relation to species. The length of the nucleus (1.35 μm for the Moroccan *P. perna*) was close to the figures given by BOURCART *ET AL.* (1965) or by BERNARD AND HODGSON (1985) for two other populations of *P. perna* (1.40 and 1.50 μm, respectively). As the nuclei of spermatozoa in other species of Mytilidae was often longer (e.g., 1.76 μm for *M. galloprovincialis*: HODGSON AND BERNARD, 1986b), this parameter might be used to identify the spermatozoa of *P. perna* from those originating from other mytilid species.

The presence of an axial rod, in the nucleus of the spermatozoon, has already been reported for most Mytilidae (BOURCART *ET AL.*, 1965; LONGO AND DORNFELD, 1967; BERNARD AND HODGSON, 1985: HODGSON AND BERNARD 1986a, b; GARRIDO AND GALLARDO, 1996; LE PENNEC AND BENINGER, 1997; KAFANOV AND DROZDOV, 1998; REUNOV, AU AND WO, 1999). The axial rod is of great importance, as it takes part in the formation of the acrosomal filament (KAFANOV AND DROZDOV, 1998) and is projected ahead in the oocyte during the acrosomal reaction (REUNOV *ET AL.*, 1999). However, in our study, the rod did not have any transversal striation and longitudinal fibrils, as the cross-striation noted by BOURCART *ET AL.* (1965) in the spermatozoa of Brazilian *P. perna*, or that described by REUNOV *ET AL.* (1999) in *Perna viridis*, and this difference might be due to intraspecific variations between the different populations of this mussel.

Proacrosomal vesicles in early developmental stages of spermatogenesis were already described in all Mytilidae studied (THIELLEY, WEPPE AND HERBAUT, 1993; REUNOV AND HODGSON 1994; GAULEJAC, HENRY AND VICENTE, 1995) and this point cannot be used to discriminate the species of Mytilidae via the study of their spermatozoa. More interesting were the shape of the acrosome for *P. perna*, the existence of a premembranoid sleeve, and the presence of three types of materials therein. The funnel-like shape of this acrosome was greatly similar to that of *M. galloprovincialis* (BERNARD AND HODGSON, 1986b) and was considered by FRANZEN (1956) an adaptation allowing the penetration of the spermatozoon through the tertiary envelope surrounding the ovum. The presence of a premembranoid sleeve in the acrosome of *P. perna* has already been observed in the spermatozoon of *M. edulis* (LONGO AND DORNFELD, 1965). However, this sleeve was seen by BERNARD AND HODGSON (1985) only in spermatids of South African *P. perna*, whereas the corresponding spermatozoa did not have such structure. Another discordance can also be noted for the three types of material (2 electron-dense zones and a third more lucent) in the acrosome. If these three types were also observed in the acrosomes of *Pinctada margaritifera* (THIELLEY *ET AL.*, 1993) and of *Choromytilus chorus* (GARRIDO AND GALLARDO, 1996), two types of material (an electron-dense zone and a more lucent) were only described in the acrosomes of South African *P. perna* (BERNARD AND HODGSON, 1985) as well as in those of other mytilids (POPHAM, 1979; HODGSON AND BERNARD, 1986a, b; GAULEJAC *ET AL.*, 1995). Moreover, a reticular structure in the dense zone of the acrosome apex was described in the Brazilian *P. perna*, whereas it was not found in the Moroccan mussels. To explain these three differences, the more likely hypothesis is to consider them intraspecific variations, probably linked to the presence of local subspecies of *P. perna* in Brazil, Morocco, and South Africa.

The structure of the *P. perna* flagellum, with 9 peripheral doublets and a single central doublet, was similar to that noted for the tails of spermatozoa which fertilized ova in sea water. The presence of short flagella in some B spermatogonia and primary spermatocytes was already reported by REUNOV AND HODGSON (1994) in other mytilids. The radiating fibers around the distal centriole were also described in the spermatozoa of several Mytilidae (REUNOV AND HODGSON, 1994) and of *Haliotis tuberculata* (BELHSEN, 2000). According to GRACIA BOZZO, RIBES, SAGRISTA, POQUET AND DURFORT (1993), such radiating fibers would allow control of the motility, direction, and speed of gametes.

Abnormal cells noted in the spermatogenesis of *P. perna* were also observed in other bivalvia by DORANGE AND LE PENNEC (1989), GAULEJAC *ET AL.* (1995), or THIELLEY *ET AL.* (1993). Indeed, the formation of giant cells, a nuclear or cytoplasmic lysis, and changes in the shape of the acrosome might be the result of accidental deviations during spermatogenesis. However, as many abnormal cells were seen in the lumina of acini, it can be assumed that these cells would be rapidly eliminated via their being carried to the male genital orifice.

In conclusion, the spermatogenesis of *P. perna* was similar to differentiations of male cells described in other bivalvia. However, several differences could be noted. The length of the nucleus, the premembranoid sleeve, and the presence of three types of material in the acrosome may be, in our opinion, efficient criteria i) to separate the Moroccan populations of *P. perna* from similar populations living in another countries, and ii) to identify the communities of this species from other Mytilidae and, in particular, from those of *M. galloprovincialis* which also lives along Moroccan coasts.

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Segunda adición a la fauna malacológica del litoral del Garraf (NE de la Península Ibérica)

Second addition to the malacological fauna of the littoral of Garraf (NE of the Iberian Peninsula)

Anselmo PEÑAS*, Emilio ROLÁN** y Manuel BALLESTEROS***

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RESUMEN

Se presenta una tercera lista de 68 especies de moluscos marinos (4 Caudofoveata, 1 Solenogastre, 32 Gastropoda, 15 Bivalvia y 16 Cephalopoda) que no habían sido citadas anteriormente en aguas del litoral del Garraf (Barcelona, NE de la Península Ibérica). De estas, 8 son citadas por primera vez en el Mediterráneo español. Además se describen tres especies nuevas para la ciencia, una del género *Alvania*, otra del género *Bela* y una tercera del género *Chrysallida*. Se incluyen comentarios sobre algunos de los taxones y se ilustran al microscopio electrónico de barrido (MEB) las conchas de varios de ellos.

ABSTRACT

A third list with 68 marine molluscs (4 Caudofoveata, 1 Solenogastre, 32 Gastropoda, 15 Bivalvia y 16 Cephalopoda) not previously recorded from the Garraf litoral (Barcelona, NE Iberian Peninsule) are presented. From these species, 8 are recorded by first time from the Spanish Mediterranean. Furthermore, three new species are described, one of the genus *Alvania*, other of the genus *Bela* and a third of the genus *Chrysallida*. Further more, some comments on some taxa are commented and the photographs (SEM) of the shells from some of them are illustrated.

PALABRAS CLAVE: Lista, Garraf, Cataluña, *Alvania, Bela, Chrysallida*, nuevas especies.
KEYWORDS: List, Garraf, Catalonia, *Alvania, Bela, Chrysallida*, new species.

INTRODUCCIÓN

El presente trabajo es una continuación de dos anteriores que se iniciarion en GIRIBET Y PEÑAS (1997). En aquella ocasión se constataba la gran riqueza malacológica de los fondos marinos de una comarca tan pequeña como el Garraf, citándose 622 especies de moluscos marinos (7 poliplacóforos, 417 gasterópodos, 190 bivalvos y 8 escafópodos). De ellos, 53 se citaban por primera vez para el Mediterráneo español. En dicho trabajo se delimitaba la zona de estudio, se incluía un mapa, se describía la variedad y particularidades de los fondos, y se añadían comentarios y fotografías al MEB sobre varios taxones.

Posteriormente GIRIBET Y PEÑAS (1998) describen en aguas del Garraf una nueva

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especie para la ciencia: *Epilepton parrusetensis;* PEÑAS Y ROLÁN (2000) citan para la zona *Turbonilla postacuticostata* Sacco, 1892; y PEÑAS Y GIRIBET (2003) presentan una segunda lista de 54 especies de moluscos marinos no citados previamente (47 gasterópodos y 7 bivalvos), de los que 18 especies se citan por primera vez para el Mediterráneo español y también se cita por primera vez en el Mediterráneo el género *Bathycrinicola*, describiendo una nueva especie: *Bathycrinicola nacraensis*.

La obtención y estudio de nuevo material recolectado entre mayo de 2003 y septiembre de 2006, así como con la publicación de los resultados de la megafauna de invertebrados no crustáceos de la campaña oceanográfica RETRO (RAMÍREZ-LLODRA, BALLESTEROS, COMPANY, DANTART Y SARDÁ, 2008) en el cañón submarino de "La Merenguera", situado frente a Vallcarca, nos ha permitido ampliar la lista de especies de moluscos marinos encontradas en aguas de esta comarca, con: 4 Caudofoveata, 1 Solenogastres, 32 Gastropoda, 15 Bivalvia y 16 Cephalopoda. Las especies del grupo Cocculiniformia, obtenidas en el cañón de "La Merenguera" fueron estudiadas anteriormente por DANTART Y LUQUE (1994). En total se conocen hasta la fecha en aguas de la comarca del Garraf 746 especies de moluscos marinos.

MATERIAL Y MÉTODOS

El material objeto de este trabajo fue obtenido en parte mediante dos dragados de arrastre por la embarcación "Teresa" de la Cofradía de Pescadores de Vilanova i la Geltrú en Mayo de 2003. El 19.5.2003 se obtuvieron unos 15 litros de sedimentos entre los caladeros "Fons de Cunit" y "Cubelles" (Zona 3), frente a la desembocadura del río Foix, en el límite sur de la comarca del Garraf, a una profundidad de 90 metros. El detrito fue lavado y pasado por una serie de tamices, siendo el más fino de 0,4 mm de luz de malla. Se estudiaron unos 5 litros del sedimento resultante. En la fracción fina predominaban las arenas.

El segundo dragado se realizó el 22.5.2003 en el lugar denominado "El Turó" (Zona 2), frente a Vallcarca, pedanía de Sitges, a una profundidad de 76 metros. Se obtuvieron unos 10 litros de detrito, del cual, después de lavado y pasado por los mismos tamices, se estudiaron unos 3 litros de sedimentos. Predominaban restos de conchas, especialmente microbivalvos.

Posteriormente, se separaron los moluscos obtenidos por algunas embarcaciones pesqueras del puerto de Vilanova i la Geltrú durante varios arrastres y se estudió el contenido estomacal de cientos de asteroideos de las especies *Astropecten aurantiacus* (Linnaeus, 1758) y *A. irregularis* (Pennant, 1777) obtenidos en los mismos. Los arrastres se realizaron en dos periodos en una misma área (Zona 1), frente a la pedanía de Vallcarca: el primero, entre los meses de marzo y mayo de 2005, entre 45 y 60 metros de profundidad, y el segundo entre mayo y septiembre de 2006, entre 35 y 50 metros de profundidad. En ambos casos se trataba de fondos detrítico-fangosos costeros, con abundancia de moluscos, en el que cerca del 80% de los ejemplares se encontraron vivos o con restos de partes blandas.

Los moluscos del cañón submarino de La Merenguera (Zona 4) fueron recolectados durante 1991 y 1992 en el transcurso de las campañas del proyecto RETRO, dedicado al estudio de las variaciones espacio temporales en la megafauna bentónica del talud continental. Los muestreos, realizados con una red de arrastre tipo OTMS, se efectuaron en tres puntos concretos del talud, talud superior (450 m), talud medio (600 m) y talud inferior (1.200 m). SARDÁ, CARTES Y COMPANY (1994) describieron las características generales de estas campañas, los puntos concretos de muestreo y la metodología utilizada, mientras que RAMÍREZ-LLODRA, BALLESTEROS, COMPANY, DANTART Y SARDÁ (2008) proporcionan los resultados de biomasa y abundancias de la megafauna de invertebrados no crustáceos en las diferentes profundidades y estaciones del año.

Las especies de Caudofoveata fueron identificadas por Lluis Dantart y por L.

Salvini Plawen. El listado de especies ha sido confeccionado de acuerdo con la sistemática y nomenclatura de la CLEMAM (Check list of European Marine Mollusca). Se han fotografiado al microscopio electrónico de barrido (MEB) las tres especies nuevas para la ciencia y también algunas de las especies nuevas para la zona de estudio, sobre las que se aporta información adicional. Las fotografías fueron realizadas por Jesús Méndez en el CACTI (Centro de Apoyo Científico y Tecnológico a la Investigación), de la Universidad de Vigo.

Abreviaturas utilizadas:

BMNH: Natural History Museum, London
MHNS: Museo de Historia Natural "Luis Iglesias", Santiago de Compostela
MNCN: Museo Nacional de Ciencias Naturales, Madrid.
MNHN: Muséum National d'Histoire Naturelle, París.
CRBA: Centre de Recursos de Biodiversitat Animal, Barcelona
MZUN: Museo di Zoologia dell'Università degli Studi di Napoli, Federico II, Nápoles
USNM: National Museum of Natural History, Smithsonian Institution, Washington
CAP: colección Anselmo Peñas, Vilanova i la Geltrú
CJA: colección José Almera, Vilassar de Mar
CMM: colección Manuel Muñoz, Vilanova y la Geltrú
CPM: colección Pasquale Micali, Fano, Italia
CRB: colección Ramón Beneito, Tarragona
v: especie encontrada viva o con restos de partes blandas
c: concha vacía
sf: subfósil
H: altura total de la concha en gasterópodos, longitud, en bivalvos
h: altura de la última vuelta
D: diámetro en gasterópodos, altura en bivalvos
=: aproximadamente igual

RESULTADOS

En el nuevo material estudiado se han identificado las siguientes especies según las zonas:

- Zona 1, Vallcarca (35-60 m profundidad): 88 especies (63 gasterópodos, 23 bivalvos y 2 escafópodos), de ellas 69 vivas (45 gasterópodos, 22 bivalvos y 2 escafópodos). Una nueva cita para el Mediterráneo español y dos nuevas especies para la ciencia.
- Zona 2, "El Turó" (76 m profundidad): 188 especies (114 gasterópodos, 70 bivalvos y 4 escafópodos), de ellas 44 vivas (18 gasterópodos y 26 bivalvos).). Una nueva cita para el Mediterráneo español y una nueva especie para la ciencia, compartida con la zona 1.
- Zona 3, "Mar de Cubelles" (90 m profundidad): 120 especies (78 gasterópodos, 48 bivalvos y 4 escafópodos), de ellas 43 vivas (9 gasterópodos y 34 bivalvos). Tres nuevas citas para el Mediterráneo español y una nueva especie para la ciencia.
- Zona 4, cañon "La Merenguera" (450-1200 m profundidad): 69 especies (4 caudofoveados, 1 solenogastro, 19 gasterópodos, 26 bivalvos, 3 escafópodos y 16 cefalópodos). Tres nuevas citas para el Mediterráneo español.

La mayoría de especies encontradas ya fueron citadas anteriormente por GIRIBET Y PEÑAS (1997) y por PEÑAS Y GIRIBET (2003). En el presente trabajo sólo se relacionan las especies no citadas previamente. En total son 68 especies pertenecientes a los siguientes grupos: 4 Caudofoveata, 1 Solenogastres, 32 Gastropoda, 15 Bivalvia y 16 Cephalopoda, cuyo listado, su presencia según la zona y su abundancia relativa puede verse en la Tabla I. De estas especies, las siguientes no habían sido registradas con anterioridad en el Mediterráneo ibérico, *Haliella stenostoma, Melanella compactilis, Pterotrachea scutata, Chrysallida monterosatii, Ch. rinaldi, Cylichnina crebvisculpta, Ennucula corbuloides* y *Limatula* cf. *bisecta*. Tres especies se citan a nivel genérico y otras tres se describen como nuevas para la ciencia, *Alvania garrafensis* spec. nov., *Bela clarae* spec. nov. y *Chrysallida dantarti* spec. nov.

Tabla I. Relación de especies encontradas y no citadas previamente. Las especies en negrita se comentan brevemente en el texto; se indica la zona o zonas en la que han sido halladas y su abundancia relativa. En la última columna se indican con su número las especies fotografiadas.
Códigos: *: primera cita para el Mediterráneo español; **: especie nueva para la ciencia; +: 1-2 ejemplares; ++: 3-10 ejemplares; +++: 11-100 ejemplares; ++++: más de 100 ejemplares; sf: subfósil; v: encontrado vivo o con restos de partes blandas.
Table I. Relation of species found and not previously recorded from the area. The species in bold are commented shortly in the text; the area and the relative abundance are mentioned. On the last column the number of the figures of the photographed species is referred.
*Code: *: first record for the Spanish Mediterranean; **: new species for science; +: 1-2 specimens; ++: 3-10 specimens; +++: 11-100 specimens; ++++: more than 100 specimens; sf: subfossil; v: alive collected or wih rest of soft parts.*

	Zona 1	zona 2	zona 3	zona 4	Figuras
Clase CAUDOFOVEATA					
Familia CHAETODERMATIDAE					
Falcidens aequabilis Salvini-Plawen, 1972				+ v	
Falcidens gutturosus (Kowalewsky, 1901)				+ v	
Familia LIMIFOSSORIDAE					
Scutopus ventrolineatus Salvini-Plawen, 1968				+ v	
Familia PROCHAETODERMATIDAE					
Prochaetoderma raduliferum (Kowalewsky, 1901)				++ v	1
Clase SOLENOGASTRES					
Familia NEOMENIIDAE					
Neomenia carinata Tullberg, 1875				+ v	
Familia COCCULINIDAE					
Coccopigya spinigera (Jeffreys, 1883)				+++ v	
Coccopigya viminensis (Rocchini, 1990)				+++ v	
Familia PSEUDOCOCCULINIDAE					
Copulabyssia corrugata (Jeffreys, 1883)				++++ v	3
Familia TROCHIDAE					
Clelandella miliaris (Brocchi, 1814)	+				
Familia CERITHIOPSIDAE					
Cerithiopsis horrida Monterosato, 1874		++			
Familia ACLIDIDAE					
Aclis ascaris (Turton, 1819)		++			
Familia EULIMIDAE					
* *Haliella stenostoma* (Jefffreys, 1858)				++++	4
* ***Melanella compactilis*** (Monterosato, 1884)	++ v				5-7
Familia RISSOIDAE					
** ***Alvania garrafensis*** Peñas y Rolán spec. nov			++		8-13
Familia LAMELLARIIDAE					
Lamellaria perspicua (Linnaeus, 1758)	++ v				
Familia NATICIDAE					
Natica prietoi Hidalgo, 1873	++ v				
Tectonatica rizzae (Philippi, 1844)	++ v				
Familia FIROLIDAE					
* *Pterotrachea scutata* Gegenbaur, 1855		++ v			
Familia MURICIDAE					
Dermomurex scalaroides (de Blainville, 1829b)	+				

Tabla I. Continuación.
Table I. Continuation.

	Zona 1	zona 2	zona 3	zona 4	Figuras
Familia CONIDAE					
** ***Bela clarae*** Peñas y Rolán spec. nov.	+++ v				14-17
Mangelia tenuicostata Brugnone, 1868	+++ v				33, 34
Familia ARCHITECTONICIDAE					
Heliacus subvariegatus (d'Orbigny, 1852)		+			
Familia PYRAMIDELLIDAE					
Chrysallida clathrata (Jeffreys, 1848)		+ sf			
* ***Chrysallida monterosatii*** (Clessin, 1900)	++++ v				39-41
** ***Chrysallida dantarti*** Peñas y Rolán spec. nov.	++ v	++			35-38
* ***Chrysallida rinaldii*** Micali y Nofroni, 2004			+		
Familia RETUSIDAE					
Retusa minutissima (Monterosato, 1878)		++			42
* ***Cylichnina crebrisculpta*** (Monterosato, 1884)	+++ v				43-45
Cylichnina nitidula (Lovén, 1846)	++++ v	++ v	+++ v		46-48
Pyrunculus hoernesii (Weinkauff, 1866)	++				
***Laona* sp.**	+				49, 50
Familia PHILINIDAE					
Philine intricata Monterosato, 1875			++		
Familia GASTROPTERIDAE					
Gastropteron rubrum (Rafinesque, 1814)				+ v	70
Familia CAVOLINIIDAE					
Creseis virgula Rang, 1828		++	+		
Familia CYMBULIIDAE					
Cymbulia peronii Lamarck, 1819				++++ v	
Familia TYLODINIDAE					
Anidolyta duebeni (Lovén, 1846)		+			
Familia PLATYDORIDIDAE					
***Baptodoris cinnabarina* Bergh, 1884**				++ v	71
Clase BIVALVIA					
Familia NUCULIDAE					
* *Ennucula corbuloides* (G. Seguenza, 1877)			++		
Familia ARCIDAE					
Anadara corbuloides (Monterosato, 1878)		++ v			
Familia MYTILIDAE					
Crenella arenaria Monterosato, 1875		+	+		
Amygdalum aglutinans (Cantraine, 1835)	++ v				
Familia LIMIDAE					
Limea loscombii G. B. I Sowerby, 1824)			+		
* ***Limatula* cf. *bisecta*** Allen, 2004			++		51, 52
Familia THYASIRIDAE					
Thyasira succisa (Jeffreys, 1876)			++		
Familia UNGULINIDAE					
Diplodonta trigona (Scacchi, 1835)			++ v		
Familia MONTACUTIDAE					
Montacuta sp.				++	
Familia SPORTELLIDAE					
Sportella sp.	+ v				53-59

Tabla I. Continuación.
Table I. Continuation.

	Zona 1	zona 2	zona 3	zona 4	Figuras
Familia TELLINIDAE					
Tellina distorta Poli, 1791	+ v				
Familia PSAMMOBIIDAE					
Gari depressa (Pennant, 1777)	++ v				
Familia SEMELIDAE					
Abra alba (W. Wood, 1802)		+++ v			63-65
Abra prismatica (Montagu, 1808)	++ v	+++ v	+		66-69
Familia CUSPIDARIIDAE					
Cardiomya costellata (Deshayes, 1835)		++ v	++		
Clase CEPHALOPODA					
Familia SEPIOLIDAE					
Neorossia caroli (Joubin, 1902)				++ v	
Heteroteuthis dispar (Rüppell, 1844)				+++ v	
Rondeletiola minor (Naef, 1912)				+ v	
Sepietta oweniana (d'Orbigny, 1839)				+ v	
Familia ENOPLOTEUTHIDAE					
Abralia veranyi (Rüppell, 1844)				+ v	
Familia ONYCHOTEUTHIDAE					
Ancistroteuthis lichtensteini (de Férussac y d'Orbigny, 1839)				++ v	73
Familia HISTIOTEUTHIDAE					
Histioteuthis reversa (Verrill, 1880)				+++ v	74
Familia BRACHIOTEUTHIDAE					
Brachioteuthis riisei (Steenstrup, 1882)				+ v	
Familia OMMASTREPHIDAE					
Todarodes sagittatus, (Lamarck, 1798)				+++ v	
Ommastrephes bartramii (Lesueur, 1821)				+ v	
Familia CHIROTEUTHIDAE					
Chiroteuthis veranyi (de Férussac, 1835)				++ v	
Familia OPISTHOTEUTHIDAE					
Opisthoteuthis calypso Verrill, 1883				++ v	
Opisthoteuthis sp.				+	75
Familia OCTOPIDAE					
Octopus salutii Vérany, 1836				++ v	
Pteroctopus tetracirrhus (Delle Chiaje, 1830)				+ v	
Eledone cirrhosa (Lamarck, 1798)				+ v	
Bathypolypus sponsalis (Fischer y Fischer, 1892)				+++ v	76

DISCUSIÓN

De la mayoría de especies citadas en este trabajo existen fotografías y descripciones actualizadas. Por tanto, nos hemos limitado a comentar o fotografiar aquellos taxones que nos han parecido de mayor interés, ya sea por su rareza o porque se aporta nueva información. También se revisan algunas citas o comentarios hechos en anteriores trabajos sobre alguna especie del Garraf. Además incluimos la descripción de tres nuevas especies para la ciencia, una perteneciente a la familia Rissoidae, una perteneciente a la familia Conidae y otra perteneciente a la familia Pyramidellidae.

Melanella compactilis (Sykes, 1903) (Figs. 5-7)

Eulima compactilis Sykes, 1903. *Journ. Moll. Stud.*, 5: 350 ex Monterosato, 1875: 35, *nomen nudum.*

Material examinado: 2 v, 2 c, Vallcarca, 45/60 m (CAP).

Especie redescrita por FRETTER Y GRAHAM (1982), quienes la citan para el oeste de las Islas Británicas, hasta una profundidad de 120 m. Esta rara especie ha sido encontrada viva también en fondos fangosos detrítico-costeros de Vilassar de Mar (ver PEÑAS, ROLÁN Y ALMERA, en prensa) y del Adriático (M. Tisselli, *com. pers.*); sin embargo, GIANNUZZI-SAVELLI, PUSATERI, PALMERI Y EBREO (1999) no la citan. Aquí se cita por primera vez para el Mediterráneo español.

Alvania garrafensis Peñas y Rolán, spec. nov. (Figs. 8-13)

Material tipo: Holotipo, con unas dimensiones de 2.8 x 1.65 mm y tres vueltas de teleoconcha (Figs. 8-10) y 4 paratipos, depositados en el MNCN (15.05/47516).
Localidad tipo: "Mar de Cubelles", comarca del Garraf (Barcelona), a 90 m de profundidad.
Etimología: El nombre específico se refiere a la comarca del Garraf donde se ha encontrado esta especie.

Descripción: Concha (Figs. 8-10) pequeña, sólida, cónica, tendente a cirtoconoidea, ancha. Color castaño claro, uniforme. Protoconcha (Fig. 11) paucispiral, de una vuelta y media (medida por el método de Verduin), con un diámetro de 410 μm; la escultura (Fig. 12) está formada por unas 12 líneas de fragmentos de cordoncillos, relativamente gruesos, irregulares, interrumpidos. Teleoconcha de espira poco elevada (h= 70% H), con 3 vueltas, la última redondeada en la periferia. Sutura profunda, no canaliculada. Escultura axial formada por unas 16 costillas, de perfil redondeado, poco robustas, ortoclinas, aproximadamente igual de anchas que sus interespacios, que desaparecen atenuadas en la periferia de la última vuelta. Escultura espiral débil, formada por cordoncillos poco marcados, cuatro entre suturas de la última vuelta, que montan ligeramente sobre las costillas, más conspicuo el situado sobre la sutura, y otros tres cordones en la base. Hay una microescultura espiral de líneas muy finas y apenas apreciables excepto a grandes aumentos (Fig. 13), además de las líneas de crecimiento. Abertura oval, ancha, peristoma continuo. Labro engrosado, en cuyo interior solo se aprecian los 2-3 dientes inferiores.

Distribución: Solo conocida en el área de estudio.

Discusión: *Alvania lanciae* (Calcara, 1845), especie infralitoral, tiene una protoconcha con un diámetro menor (360 μm) y 0.2 vueltas menos; la concha tiene un perfil más cónico regular, las vueltas son menos convexas, la sutura es canaliculada, la escultura es muy marcada, robusta, con menos costillas y más cordones espirales, y tiene microescultura reticular entre las costillas bien marcada

Alvania lineata Risso, 1926, especie infralitoral, asociada a praderas de *Posidonia oceanica* y algas fotófilas, tiene una protoconcha con un diámetro menor (350 μm), la concha es mucho mayor, proporcionalmente más estrecha, las vueltas son casi planas, la última ovalada en la periferia, la sutura es canaliculada, la escultura es muy marcada formando gránulos en el cruce de costillas y cordones espirales, y la abertura es pequeña.

Alvania electa (Monterosato, 1874) tiene una concha más pequeña y ventruda, las costillas son más prominentes, con un perfil casi anguloso, tiene más cordoncillos espirales entre suturas y en la base, que son conspicuos y la protoconcha tiene 0,25 vueltas menos, un diámetro menor y una microescultura dife-

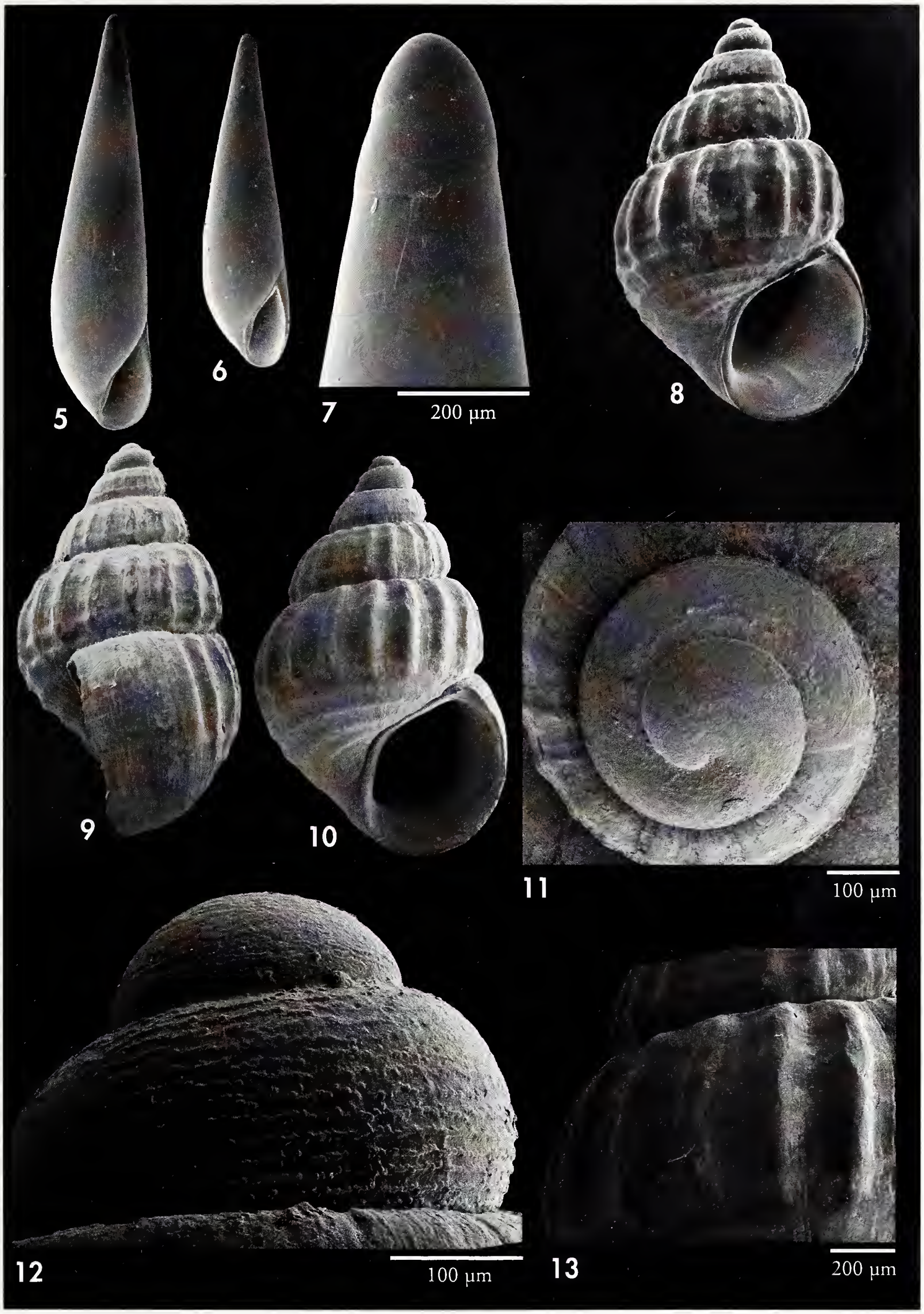
Figura 1. *Prochaetoderma raduliferum.* Figura 2. *Neomenia carinata.* Figura 3. *Copulabyssia corrugata.* Figura 4. *Haliella stenostoma.*
Figure 1. Prochaetoderma raduliferum. *Figure 2.* Neomenia carinata. *Figura 3.* Copulabyssia corrugata. *Figure 4.* Haliella stenostoma.

rente, formada por estrías espirales delgadas y espaciadas.

Alvania subsoluta (Aradas, 1847) tiene un color blanco, con las vueltas muy convexas, la última redondeada, tiene más costillas, al menos 30, más estrechas, tiene más cordoncillos espirales, la abertura es sublunar y la protoconcha tiene un diámetro mayor y su microescultura es diferente formada por 8-10 cordoncillos espirales muy delgados.

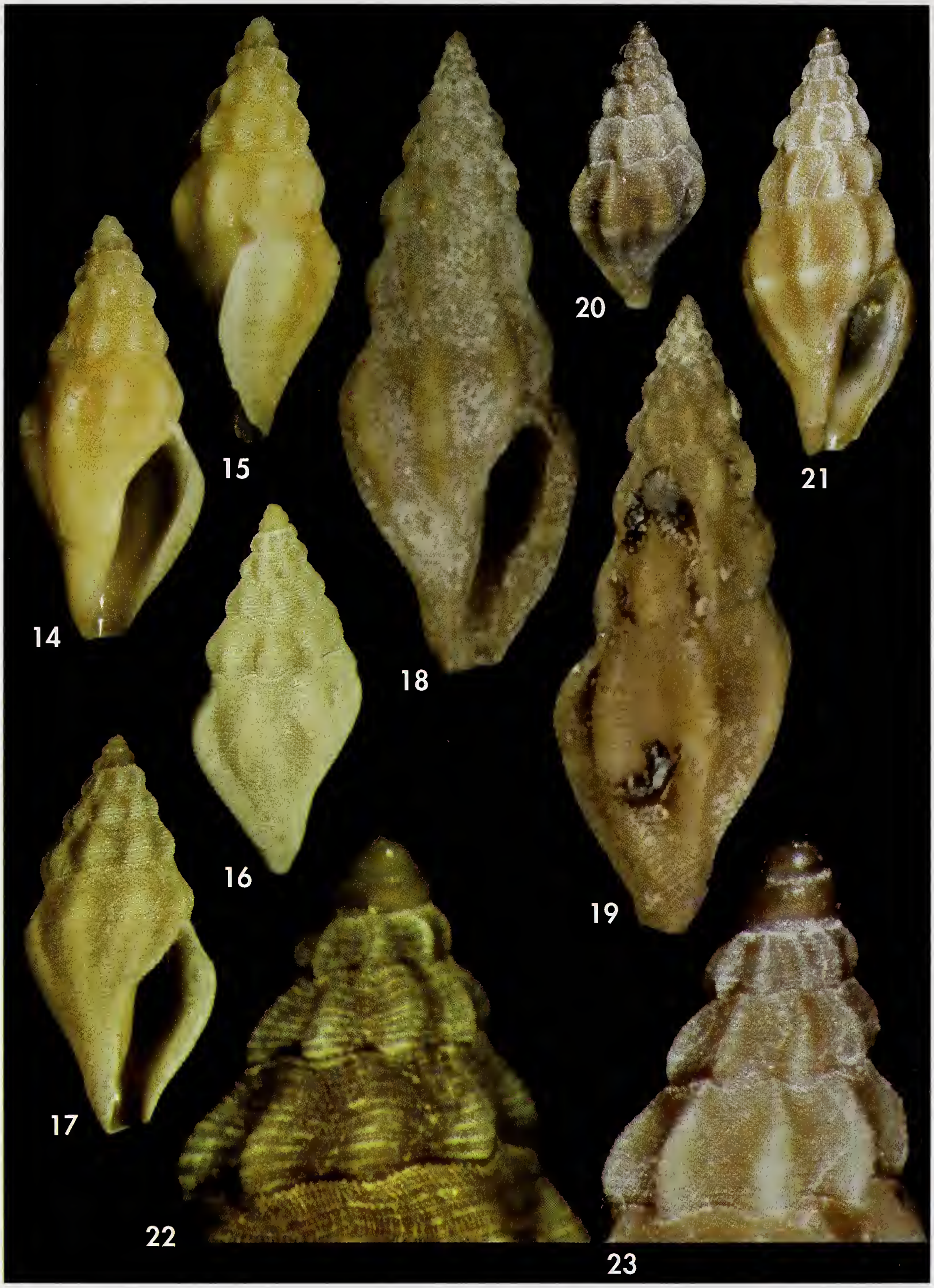
Bela menkhorsti van Aartsen, 1988 (Figs. 18-21, 23, 24-26)

Pleurotoma nana Scacchi, 1836 (non Deshayes, 1835). *Cat. Regni Napolitana*: pag. 13, nº 20, fig. 20 [Localidad tipo: Nápoles, Italia].
Bela nana Spada, Sabelli y Morandi, 1973. *Conchiglie*, 9 (3-4): 65, lám. 4, fig. 3.
Bela (Íshnula) turgida Nordsieck, 1977. *The Turridae of the European Seas*, 45, fig. A.91.
Bela turgida Ghisotti, 1978. *Conchiglie*, 14 (9-10): 163, fig. 7.
Bela menkhorsti Mifsud, 1998. *La Conchiglia*, 30 (287): 41, fig. 20.



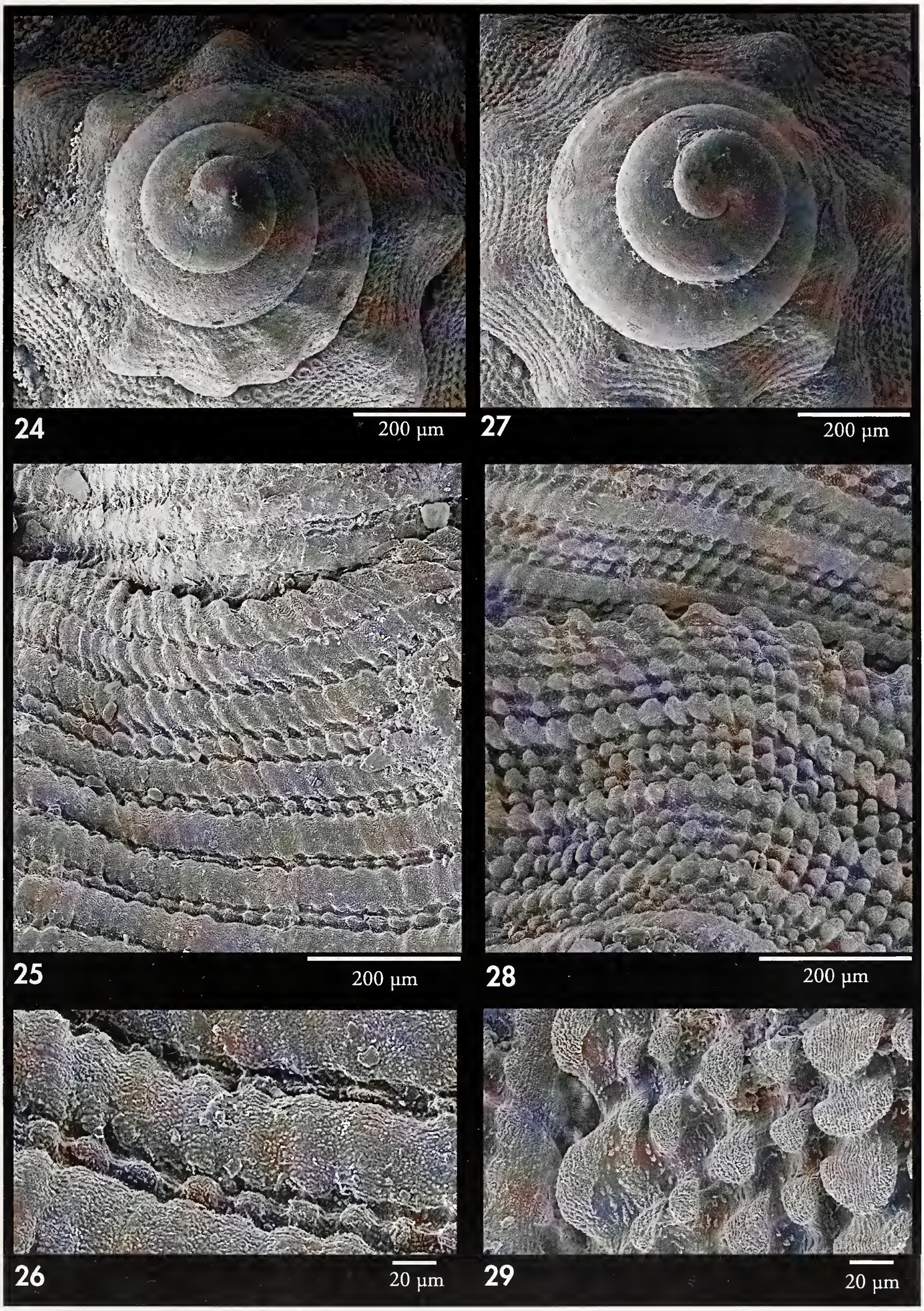
Figuras 5-7. *Melanella compactilis*. 5, 6: conchas, 4,5 y 3,3 mm; 7: protoconcha. Figuras 8-13. *Alvania garrafensis* spec. nov. 8-10: holotipo, 2,8 mm (MNCN); 11: protoconcha; 12: microescultura de la protoconcha; 13: detalle de la teleoconcha.

Figures 5-7. Melanella compactilis. *5, 6: shells, 4.5 and 3.3 mm; 7: protoconch. Figures 8-13.* Alvania garrafensis *spec. nov. 8-10: holotype, 2.8 mm (MNCN); 11: protoconch; 12: microsculpture of the protoconch; 13: detail of the teleoconch.*



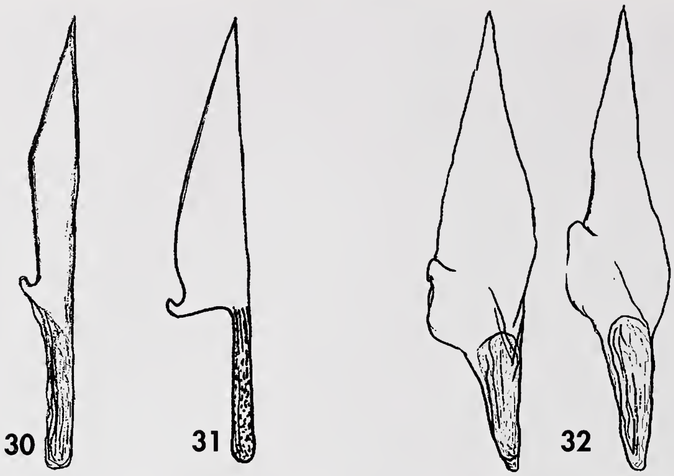
Figuras 14-17. *Bela clarae*. 14, 15: holotipo, 7,6 mm (MNCN); 16, 17: paratipos, 6,2 y 7,0 mm (MHNS). Figuras 18-21. *Bela menkhorsti*. 18, 19: lectotipo, aquí designado, de *Pleurotoma nana*, 11 mm (MNHN); 20, 21: conchas, 5,4 y 7,6 mm (CAP). Figura 22. Protoconcha de *Bela clarae* (MHNS). Figura 23. Protoconcha de *Bela menkhorsti* (CAP).

Figures 14-17. Bela clarae. *14, 15: holotype, 7,6 mm (MNCN); 16, 17: paratypes, 6.2 and 7.0 mm (MHNS). Figures 18-21.* Bela menkhorsti. *18, 19: lectotype, here designated, of* Pleurotoma nana, *11 mm (MNHN); 20, 21: shells, 5.4 and 7.6 mm (CAP). Figure 22. Protoconch of* Bela clarae *(MHNS). Figure 23. Protoconch of* Bela menkhorsti *(CAP).*



Figuras 24-26. *Bela menhorski*. 24: protoconcha; 25: microescultura; 26: la misma con mayor aumento. Figuras 27-29. *Bela clarae*. 27: protoconcha; 28: microescultura; 29: la misma con mayor aumento.

Figures 24-26. Bela menhorski. *24: protoconch; 25: microesculpture; 26: same at higher magnification. Figures 27-29.* Bela clarae. *27: protoconch; 28: microesculpture; 29: same at higher magnification.*



Figuras 30-32. Dientes radulares de *Bela*. 30: *Bela clarae*, de un ejemplar de 9,2 mm; 31: *Bela menkhorsti*, de un ejemplar de 7 mm; 32: *Bela laevigata*, de un ejemplar de 9,6 mm.
Figures 30-32. Radular teeth of Bela. *30:* Bela clarae, *from a specimen 9.2 mm; 31:* Bela menkhorsti, *from a specimen 7 mm; 32:* Bela laevigata, *from a specimen 9.6 mm.*

Bela menkhorsti VAN AARTSEN, 1988. *La Conchiglia*, 20 (232-233): 30. *Nomen novum* pro *Pleurotoma nana* Scacchi, 1836 non Deshayes, 1835.

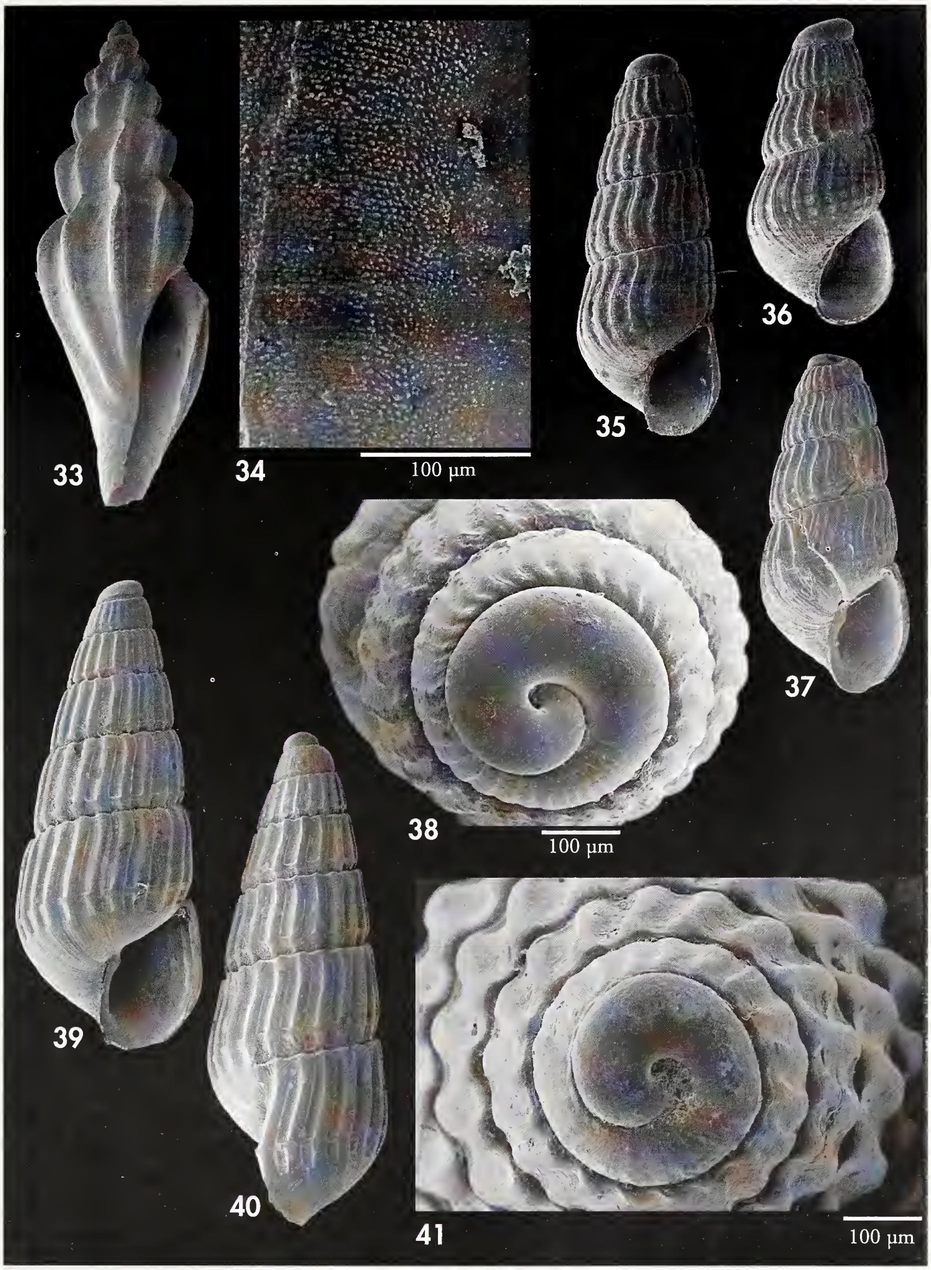
Material tipo: 3 sintipos de *Pleurotoma nana*, MNHN nº Moll 3149, procedentes de Pausilipo, Nápoles, Italia. El ejemplar ilustrado (Figs. 18, 19) mide 11 x 4,7 mm.
Material examinado: 30 v, 5 c, Vallcarca, Sitges, 35/60 m (CAP); 34 c, Vallcarca, Sitges, 35/60 m (CMM); 5 c, 2 j, "Mar de Nacra", Sitges, 90 m (CAP). 50 v, 54 c, Vilassar de Mar, -45 m (CAP); 20 v, 57 c, Vilassar de Mar, 45 m (CJA); 1 c, Vilassar de Mar, -45 m (CPM); 2 c, Almería, -30 m (CAP); 2 c, Porto Cesareo, Italia, 35 m (CAP).

Comentarios: SCACCHI (1836) la describe así: "*Testa parva ovato-ventrosa, rufofusca, linea pallidiore per médium ultimi anfractus decurrente; striis transversis exilissimis; costique in longum digestis; labro acuto*". Queda claro, pues, que la concha de la especie de Scacchi es de color castaño oscuro con una estrecha banda de color claro en el centro de la última vuelta.

MIFSUD (1998) describe el animal diciendo "el color del animal es transparente blanquecino con manchas esparcidas y opacas, blanco lácteo. Hay una gran cantidad de puntos rosa-anaranjado por todas partes".

Según AARTSEN (1988a) *Pleurotoma fortis* Reeve, 1844 y *P. turgida* Reeve, 1844 deben considerarse *nomina dubia* ya que son inidentificables, desconociéndose las localidades tipo de ambas. Por el contrario, AARTSEN (1988b) considera válida la especie *Pleurotoma nana* Scacchi, 1836 y al estar preocupado el nombre por *P. nana* Deshayes, 1835, (lo que ya había sido mencionado por GHISOTTI, 1978), le da el nuevo nombre de *B. menkhorsti*. Ambos autores, así como CRETELLA, CROVATO, CROVATO, FASULO Y TOSCANO (2005) creen que el material tipo ha desaparecido del MZUN. Sin embargo existen 3 sintipos de *P. nana* en el MNHN (nº Mol 3149), uno de los cuales se ilustra aquí. (Figs. 18, 19)

Se acepta la validez de *B. menkhorsti* como *nomen novum* para *B. nana*, si bien creemos que la ilustración de AARTSEN (1988b: fig. 1) no se corresponde con la verdadera *B. nana* sino con la especie que será descrita más abajo como *B. clarae*. El



Figuras 33, 34. *Mangelia tenuicostata*. 33: concha, 6,6 mm (CAP); 34: microescultura. Figuras 35-38. *Chrysallida dantarti* spec. nov. 35: holotipo, 1,7 mm (MNCN); 36, 37: paratipos, 1,3 y 1,46 mm (MNCN); 38: protoconcha. Figuras 39-41. *Chrysallida monterosatii*. 39, 40: conchas, 2,2 y 2,3 mm (CAP); 41: protoconcha.

Figures 33, 34. Mangelia tenuicostata. *33: shell, 6.6 mm (CAP; 34: microsculpture. Figures 35-38.* Chrysallida dantarti *spec. nov. 35: holotype, 1.7 mm (MNCN); 36, 37: paratypes, 1.3 and 1.46 mm (MNCN); 38: protoconch. Figures 39-41.* Chrysallida monterosatii. *39, 40: shells, 2.2 and 2.3 mm (CAP); 41: protoconch.*

problema proviene de que erróneamente se han identificado como una misma especie dos taxones parecidos, que comparten un mismo hábitat. *B. menkhorsti* y *B. clarae*, son especies diferentes aunque, en conchas rodadas, las diferencias apenas se aprecian, con la excepción de una banda estrecha de color claro en el centro de la última vuelta, que es típica de *B. mekhorsti*. Más adelante se detallan las diferencias entre ambas especies. Se aporta fotografia al SEM de la protoconcha (Fig. 24), microescultura (Fig. 25) y esta misma con gran aumento (Fig. 26).

Bela clarae Peñas y Rolán spec. nov. (Figs. 14-17, 22, 27-29)

Material tipo: Holotipo (Figs. 14, 15) con unas dimensiones de 7,6 x 3,4 mm y 5 vueltas de teleoconcha, y 3 paratipos, depositados en el MNCN (15.05/47517). Otros paratipos en las siguientes colecciones: MNHN (1 s), MHNS (2 s, Figs. 16, 17), BMNH (1 s), USNM (1 s), AMNH (1 s), CRBA (2 s), CAP (10 v, 25 c) y CMM (3 c, 5 j): todos procedentes de la localidad tipo. Otros paratipos: 6 c, "El Turó", Vallcarca, Barcelona, 76 m (CAP); 3 c, "Mar de Nacra", Sitges, 105 m (CAP); 15 v, 12 c, Vilassar de Mar, Barcelona, 45 m (CAP); 30 v, 55 c, Vilassar de Mar, Barcelona, 45 m (CJA); 1 c, Vilassar de Mar, Barcelona, 45 m (CPM); 2 c, San Carlos de la Rápita, Tarragona, dragado 30 m (CJA).
Otro material examinado: Dos ejemplares de la localiad tipo fueron destruidos para el estudio radular; 2 c, Málaga, 60 m (CRB). 3 c, Nerja, Málaga, 40 m (CAP); 1 c, Islas Gorgona, Arch. Toscano, Italia, 130 m (CPM); 2 c, Pesaro, Italia, 60 m (CPM); 3 c, Malta, 60/80 m (CPM).
Localidad tipo: Vallcarca, Sitges, Barcelona, 45/60 m de profundidad, en fondo detrítico fangoso.
Etimología: El nombre específico se dedica a Clara Peñas Magro, nieta del primero de los autores.

Descripción: Concha (Figs. 14-17) pequeña, sólida, fusiforme, casi romboide. Monocroma, color crema uniforme, tendente al castaño claro, no brillante; en algunos ejemplares las costillas son ligeramente más claras; sin banda alguna de color. Protoconcha (Figs. 22, 27) brillante, con un núcleo liso de 84 μm, y unas dos vueltas y cuarto, de color ligeramente más claro que la teleoconcha, y con un diámetro de 476 μm. La protoconcha es lisa al principio y en la última vuelta, hay costillas axiales que apenas se insinúan bajo la sutura y, en la última media vuelta, son unas 22 cada vez menos marcadas, con algunos cordones espirales poco evidentes. Teleoconcha de unas 4 a 5 vueltas, angulosas, con 7-8 costillas axiales por vuelta, más prominentes en su parte media, que se desvanecen hacia la base. Abertura casi romboidal que se continúa hacia la base con un corto y ancho canal sifonal. Columela formando ángulo en su centro; labio externo fino, y cortante, con una escotadura sifonal pronunciada en su parte superior. La microescultura (Figs. 28) está formada por nódulos pequeños, irregulares, elevados y unidos espiralmente por un microcordón. Con grandes aumentos (Fig. 29) estos nódulos muestran una microescultura muy irregular como el trenzado de un tejido de lana.

Dimensiones: el holotipo mide 7,6 x 3,4 mm; algunos ejemplares alcanzan los 10 x 4 mm.

El animal no pudo ser observado vivo, pero en material conservado en alcohol parecía tener una coloración crema-amarillenta. Carece de opérculo.

Rádula muy pequeña, con unos 7-8 pares de dientes (Fig. 31) marginales, alargados, con forma de cuchillo, con una parte basal alargada y más estrecha y otra apical, afilada y algo más ancha. Entre ambas existe una prominencia algo curvada hacia arriba. La longitud del diente radular es de unas 90 μm. Por su forma, tiene una cierta semejanza con los dientes radulares de algunas especies del género *Mangelia* Risso, 1826 (Powell, 1966, fig. 129) así como de otras de este género en Angola representadas en Rolán y Otero-Schmitt (1999, figs. 83-85).

La ilustración de Oliver Baldoví (2007) al MEB, como *B. menkhorsti*, pertenece a esta especie.

Distribución: Mediterráneo español, circalitoral, especialmente en fondos fangoso-detríticos. Creemos que esta

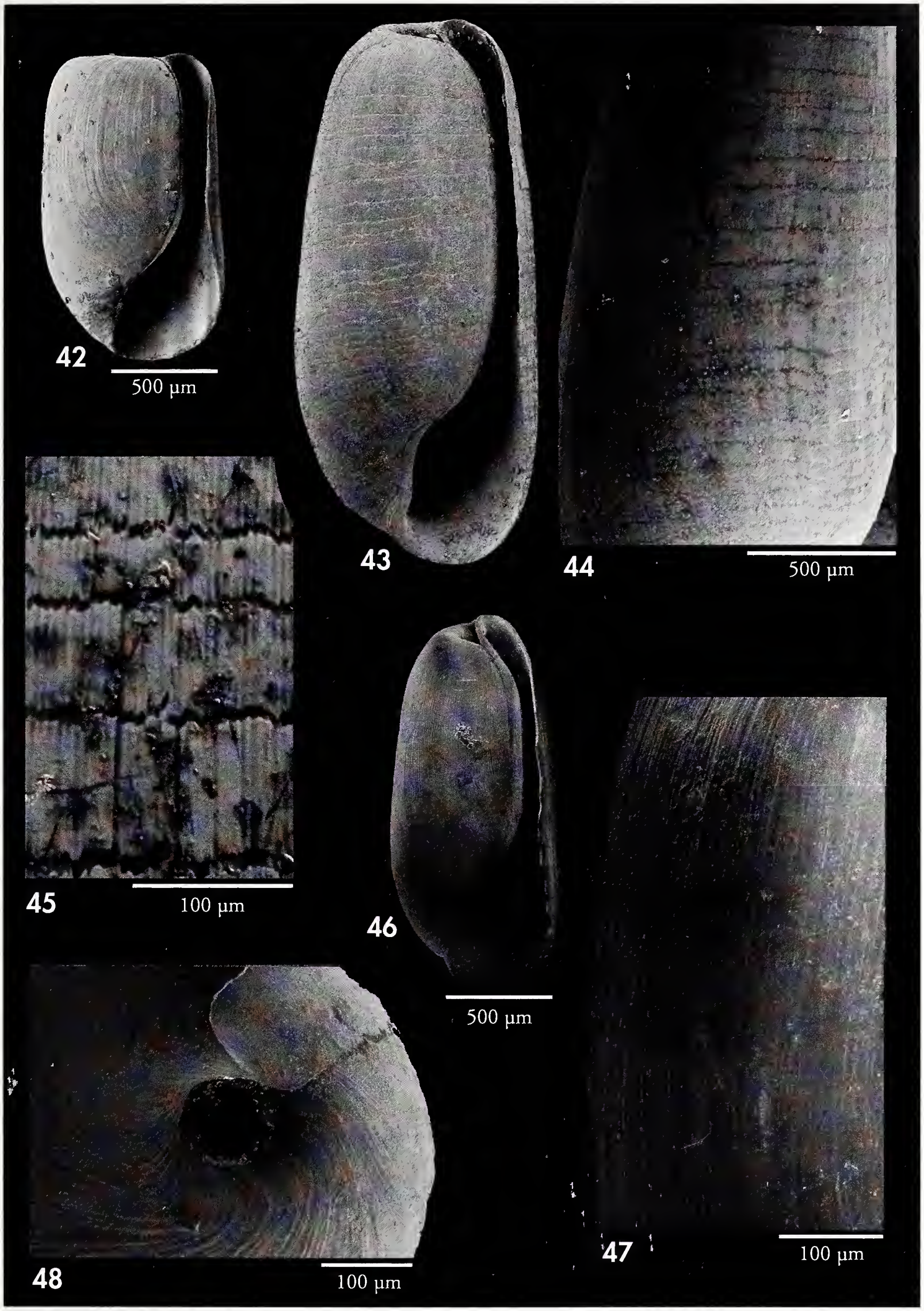


Figura 42. *Retusa minutissima*, concha, 1,4 mm (CAP). Figuras 43-45. *Cylichnina crebrisculpta*. 43: concha, 6,3 mm (CAP); 44, 45: escultura y microescultura. Figuras 46-48. *Cylichnina nitidula*. 46: concha, 1,7 mm (CAP); 47: detalle de la escultura; 48: visión apical.

Figure 42. Retusa minutissima, *shell, 1.4 mm (CAP). Figures 43-45.* Cylichnina crebrisculpta. *43: shell, 6.3 mm (CAP); 44, 45: sculpture and microsculpture. Figures 46-48.* Cylichnina nitidula. *46: shell, 1.7 mm (CAP); 47: detail of the sculpture; 48: apical view.*

especie vive, aunque no es común, en todo el Mediterráneo.

Discusión: La especie más cercana es *B. menkhorsti*, con la que existen claras diferencias:

- Color: *B. menkhorsti* tiene un color castaño, oscuro en conchas frescas, con un banda estrecha de color claro, visible en el centro de la última vuelta. *B. clarae* es monocroma, de color crema.

- Forma: *B. menkorsti* es más esbelta, con una relación H/D= 2.5 de media, aunque el sintipo ilustrado tiene una relación de 2.75. *B. clarae* es más ancha, de perfil romboide, angulosa en la periferia de la última vuelta, con una relación H/D= 2.3 de media; el holotipo tiene una relación de 2.2.

- Protoconcha: la de *B. menkhorsti* es más ancha, pudiendo alcanzar un diámetro de hasta 650 µm. El núcleo parece algo menor, pero no se midieron suficientes ejemplares como para darle un valor estadístico.

- Microescultura: la de *B. menkhorsti* (Fig. 25) tiene una alternancia de cordones nodulosos con otros con nódulos alargados en sentido axial que parecen dos fusionados. Con grandes aumentos (Fig. 26), la microescultura que se aprecia sobre los nódulos está formada por tubérculos muy finos y apretados, diferente de la que aparece en *B. clarae*.

- Rádula: El diente radular (Fig. 30) de *B. clarae* es algo parecido al de *Bela menhorsti* (Fig. 31), siendo en cambio bastante diferente del de *Bela laevigata* (Fig. 32). Todo ello parece mostrar una relación de proximidad del género *Bela* con el género *Mangelia*, al tiempo que una gran variabilidad en la morfología del diente radular dentro de ambos géneros.

También tiene bastante semejanza en su tamaño y forma con *Brachycythara atlantidea* (Knudsen, 1952). Esta especie aparece representada en ROLÁN & OTERO-SCHMITT (1999) incluyendo el holotipo, y presenta algunas diferencias con la especie aquí descrita: su color es blanco sucio, su protoconcha tiene un diámetro mayor (más de 700 µm) y unas 3 vueltas de espira o algo menos; la primera vuelta de la protoconcha es lisa y la segunda tiene muchas costillitas axiales juntas, pero en la última media vuelta, estas se separan y se hacen más prominentes, siendo apenas unas 12, mientras los cordones espirales son marcados.

B. decussata (Locard, 1892) tiene una concha mayor, mucho más esbelta, con una relación H/D= 3, las vueltas son convexas, no angulosas en su zona central, las costillas son oblicuas en la zona adapical, el color es grisáceo, sin banda de color claro.

Mangelia tenuicostata (Brugnone, 1868) (Figs. 33, 34)

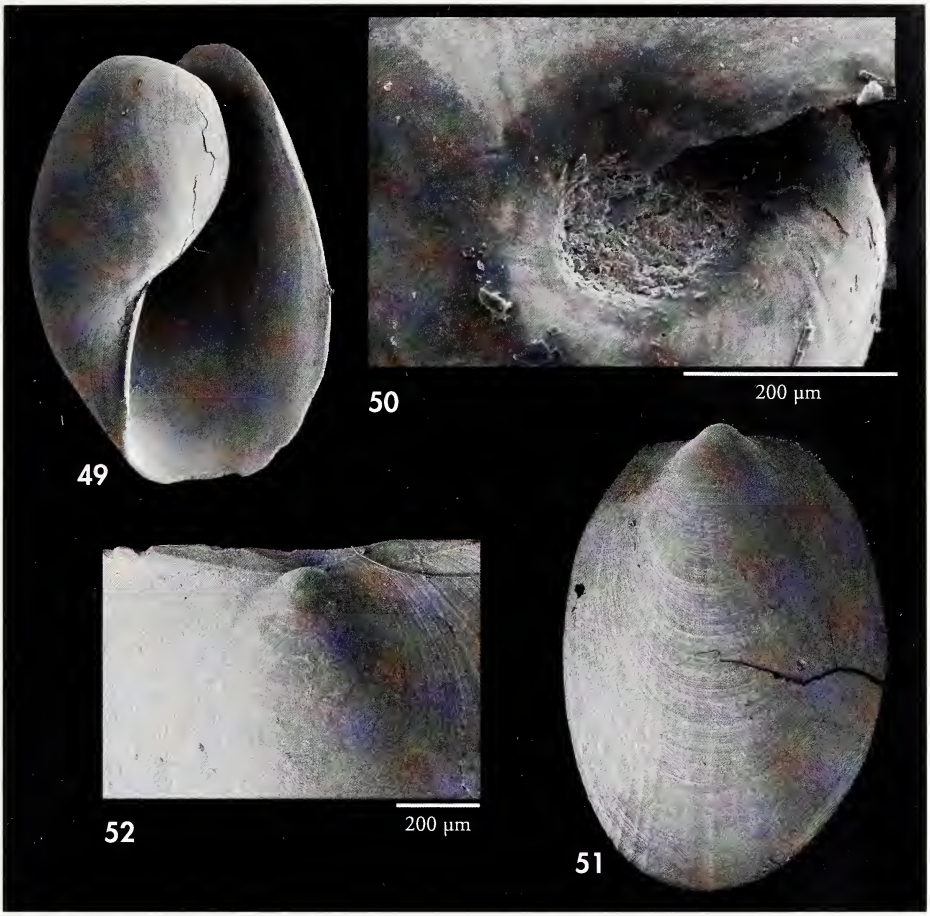
Pleurotoma attenuata var. *tenuicostata*, Brugnone, 1868. *Mem. Pleurot. Palermo*: 25, fig. 17.

Nuevo material examinado: 20 v, 55 c, Vallcarca, 35/60 m (CAP); 35 c, "El Turó", 76 m (CAP); 3 c, "Cubelles", 90 m (CAP).

Tanto SABELLI, GIANNUZZI-SAVELLI Y BEDULLI (1992), como GIRIBET Y PEÑAS (1997) dudaban de la validez de esta especie, y la consideraban sinónimo de *M. attenuata* (Montagu, 1803), forma propia de aguas profundas. SOLUSTRI Y MICALI (2002) redescriben *M. tenuicostata*, considerándola válida y diferente de *M. attenuata*, tesis que actualmente compartimos. La superficie de su concha está formada por microscópicos tubérculos, más atenuados en los interespacios que sobre las costillas.

Chrysallida dantarti Peñas y Rolán spec. nov. (Figs. 35-38)

Material tipo: Holotipo (Fig. 35), con unas dimensiones de 1.5 x 0.6 mm y 3 paratipos (Figs. 27, 28), depositados en el MNCN (15.05/47518)



Figuras 49, 50. *Laona* sp. 49: concha, 1,6 mm (CAP); 50: visión apical. Figuras 51, 52. *Limatula* cf. *bisecta*. 51: valva, 14,6 mm (CAP); 52: detalle del umbo.
Figures 49, 50. Laona *sp. 49: shell, 1.6 mm (CAP); 50: apical view. Figures 51, 52.* Limatula *cf.* bisecta. *51: valve, 14.6 mm (CAP); 52: detail of the umbo.*

Otro material examinado: 4 conchas, procedentes de "El Turó", Sitges, 76 m de profundidad.
Localidad tipo: Vallcarca, Sitges (Barcelona), en fondo fangoso detrítico, a 45/60 m de profundidad.
Etimología: El nombre específico se dedica a Lluis Dantart, malacólogo de Barcelona, recientemente fallecido.

Descripción: Concha (Figs. 35-37) diminuta, sólida, subcilíndrica. Color blanquecino, brillante, opaca. Protoconcha (Fig. 38) obtusa, del tipo C, proporcionalmente ancha, con un diámetro de unas 290 μm. Teleoconcha de espira poco elevada (h= 50% H), con 4 vueltas planoconvexas, la convexidad situada en el tercio inferior de las vueltas, última vuelta casi redondeada en la periferia. Sutura poco profunda. Escultura axial formada por unas 24 costillas bien marcadas pero no robustas, de perfil redondeado, ligeramente opistoclinas, flexuosas, más anchas que sus interespacios, que desaparecen atenuadas en la periferia de

la última vuelta, mientras que los interespacios se interrumpen bruscamente. Base lisa, salvo las líneas de crecimiento. Escultura espiral tenue, solo en los interespacios, formada por 1-2 cordoncillos espirales en las vueltas anteriores, situados sobre la sutura, y 3 cordoncillos en la última vuelta, el inferior situado en la periferia. Abertura piriforme, columela arqueada, con un diente columelar en posición algo interna en la abertura, pero evidente. Labro no engrosado.

Distribución: Solo conocida en el área de estudio, entre 45 y 76 m de profundidad.

Discusión: *Chrysallida suturalis* (Philippi, 1844) tiene una concha más bien cirtoconoidea, mayor, más estrecha (H/D= 2.9 frente a 2.6 de media en *C. dantarti*), con la espira más elevada, la última vuelta es ovalada en la periferia, la sutura es profunda, las costillas se prolongan en la base, en la última vuelta solo tiene 2 cordones espirales y la protoconcha tiene un diámetro menor.

C. rinaldii Micali y Nofroni, 2004 tiene una protoconcha más prominente, del tipo B, la concha es cirtoconoidea, con la espira más corta, tiene más costillas, en la última vuelta solo tiene 2 cordoncillos espirales y el diente columelar apenas es apreciable.

C. indistincta (Montagu, 1808) tiene una concha mayor, tiene menos costillas, robustas, prolongadas en la base, tiene al menos un cordón espiral más, situado por debajo de la periferia de la última vuelta, y carece de diente columelar.

Peñas, Templado y Martínez (1996, fig. 47) ilustran una concha procedente de Isla Palomas, Murcia, considerándola una forma del variable taxon *C. interstincta* (J. Adams, 1797). Esa forma ha sido encontrada también en varias localidades del mar de Alborán y probablemente se trate de una especie diferente de *C. interstincta*, pendiente de discusión. Esa forma, de aguas someras, tiene una concha mayor, cónica, más ancha (H/D= 2 frente a 2.6 en *C. dantarti*), las vueltas son casi planas, la escultura espiral es más conspicua, y tiene una protoconcha más aguda, con un diámetro menor.

Chrysallida monterosatii (Clessin, 1900) (Figs. 39-41)

Pyrgulina brevicula Monterosato, 1884. *Nomen. gen. e spec.*: 88. Not *Odostomia brevicula* Jeffreys, 1883.
Parthenia monterosatii Clessin, 1900. *Die familia der Eulimidae*, vol 1, nº 28, part 457: 188.
Parthenia alleryi Kobelt, 1903. *Iconog. Schal. Europ Meeresconch.*: 134, lám. 73, figs. 9, 10.

Material examinado: Más de 200 conchas, Vallcarca, 45/60 m, la mayoría con restos de partes blandas (CAP).

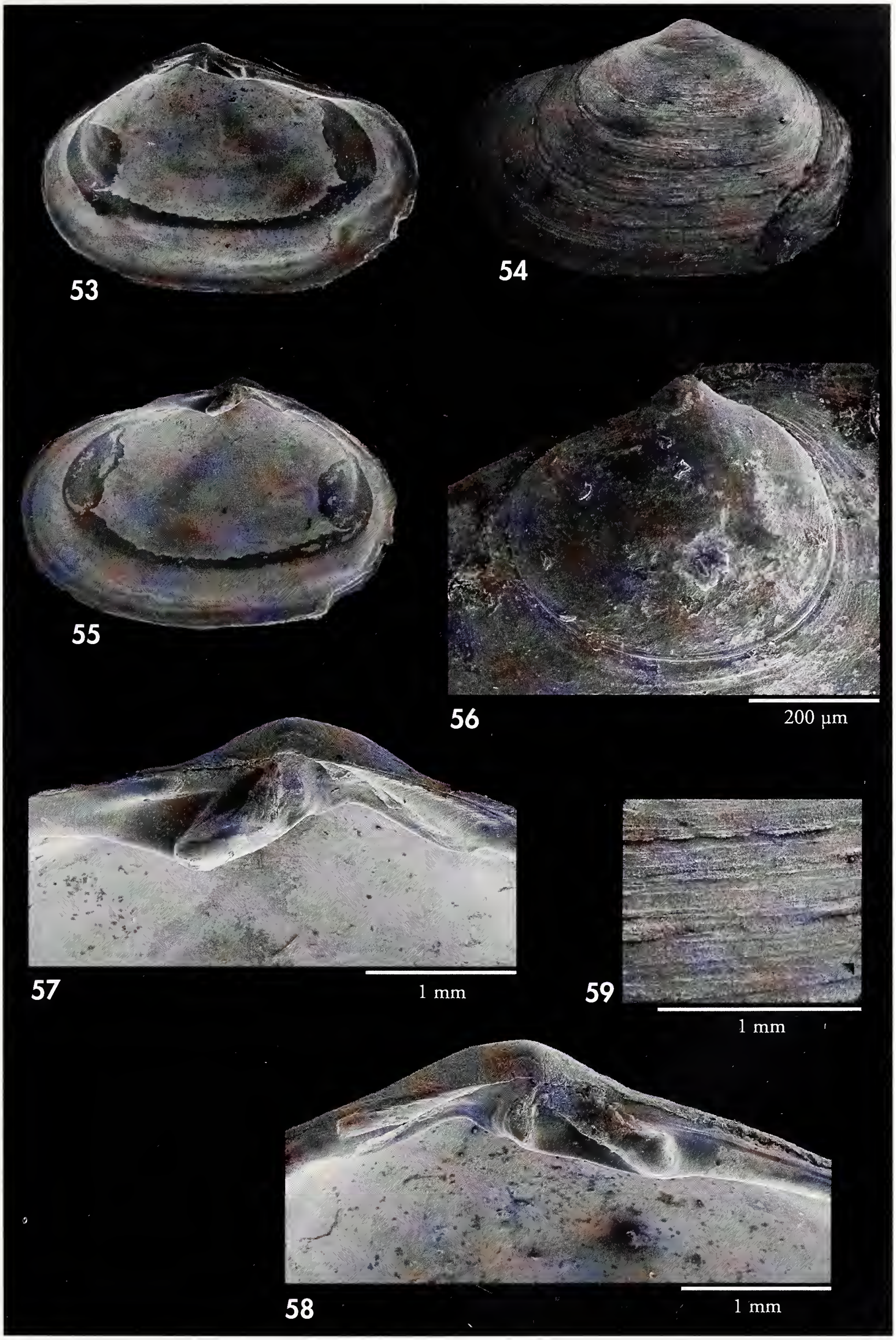
Especie redescrita por Micali, Nofroni y Aartsen (1993), quienes la citan para el Mar Tirreno entre 50 y 200 m. Se ha encontrado abundante en el estómago de *Astropecten irregularis*, frente a Vallcarca, entre 35 y 60 m de profundidad, siendo ésta la primera cita para el Mediterráneo español.

Esta especie se caracteriza por su forma tronco-cónica regular, las vueltas planas, la sutura somera, las primeras 1-2 vueltas de la teleoconcha lisas o con las costillas obsoletas, las costillas son casi rectas, opistoclinas, el cordoncillo espiral es muy delgado y el diente columelar es conspicuo.

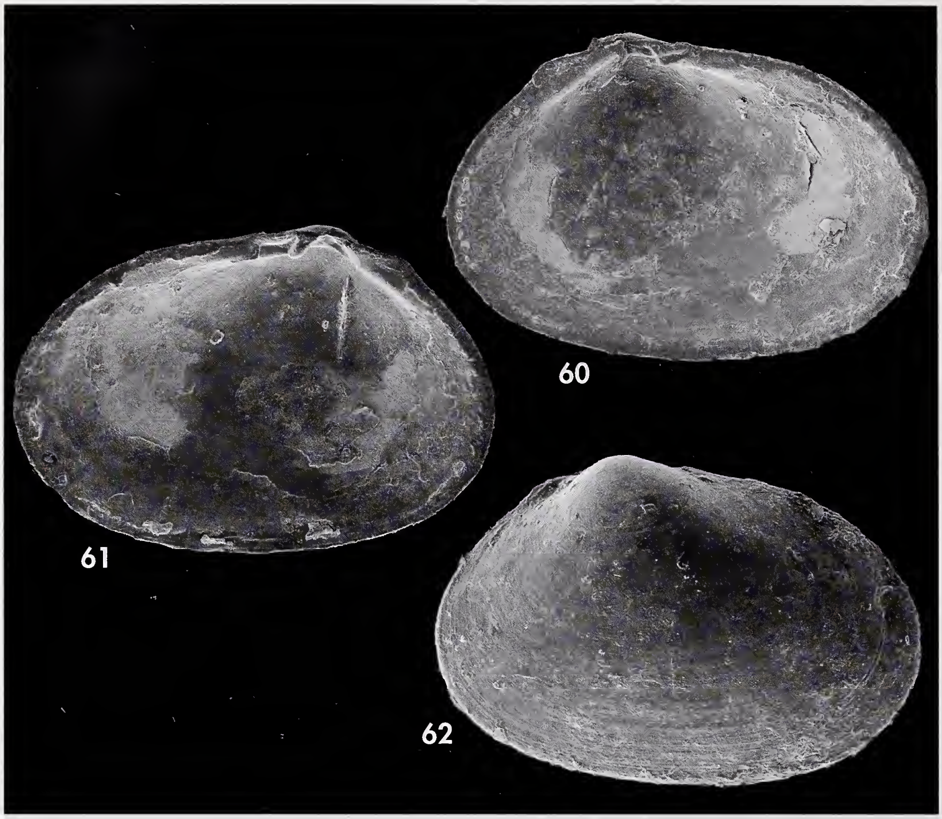
Chrysallida rinaldii Micali y Nofroni, 2004

Chrysallida rinaldii Micali y Nofroni, 2004. *Bollettino Malacologico*, 39 (9-12): 177-180. [Localidad tipo: Isla Marettimo, Islas Eagadi, Sicilia, Italia, 80-100 m].

Material examinado: 2 c, "El Turó", 76 m (CAP).



Figuras 53-59. *Sportella* sp. 53-55: Valvas de un ejemplar de 10,2 mm (CAP); 56: prodisoconcha; 57, 58: detalle de la articulación; 59: detalle de la escultura.
Figures 53-59. Sportella *sp. 53-55: Valves of a specimen 10.2 mm (CAP); 56: prodissoconch; 57, 58: detail of the hinge; 59: detail of the sculpture.*



Figures 60-62. *Montacuta* sp., valvas de un ejemplar, 1,27 mm (CAP).
Figuras 60-62. Montacuta *sp., valves of a specimen, 1.27 mm (CAP).*

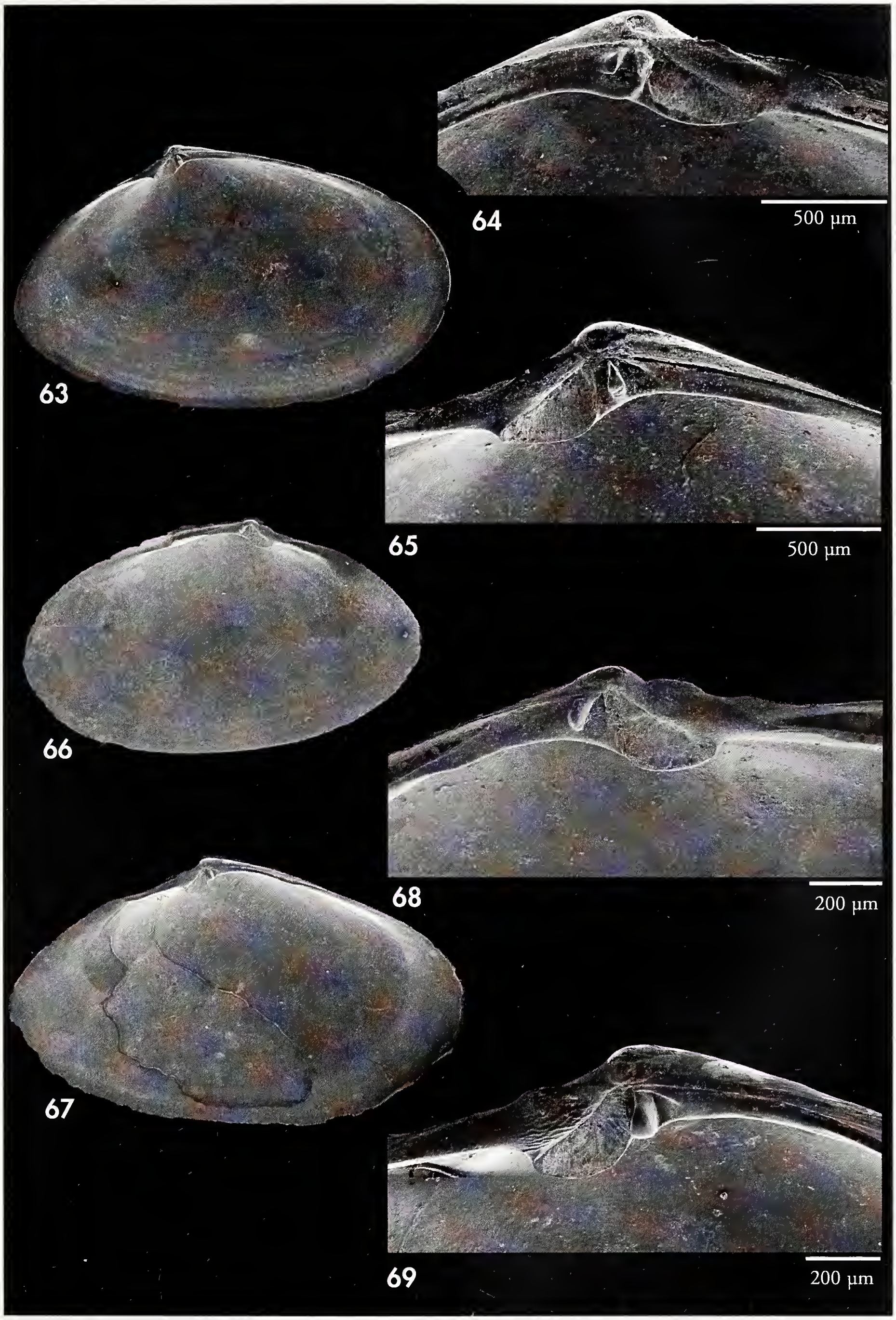
Las dos conchas encontradas son la primera cita para el Mediterráneo español. Esta diminuta especie, cercana a C. *penchynati* (B. D. D., 1883), tiene una protoconcha relativamente grande, del tipo B, la concha es cirtoconoidea, la sutura es profunda, tiene unas 25 costillas y el diente columelar está atrasado, apenas visible. Ver ilustración en MICALI Y NOFRONI (2004).

Retusa minutissima (Monterosato, 1878) (Fig. 42)

Utriculus minutissimus Monterosato, 1878 ex H. Martin ms. *Journ. De Conchyl.*, 26 : 159.

Material examinado: 7 c, "El Turó", 76 m (CAP); 60 c, puerto de Los Alfaques, San Carlos de la Rápita, Tarragona (CAP).

OLIVERIO Y TRINGALI (2001) ilustran varios sintipos, consideran que esta especie ha sido erróneamente ubicada en el género *Pyrunculus*, cuando en realidad es una *Retusa* y también fundamentan las diferencias con *Retusa obtusa* (Montagu, 1803). Los mismos autores citan e ilustran un ejemplar procedente de Valencia. Previamente MARTÍNEZ RUEDA Y PEÑAS (1993) habían citado esta especie para La Herradura, Granada, primera cita que se hacía para el Mediterráneo español.



Figuras 63-65. *Abra alba*. 63: concha, 6 mm (CAP); 64, 65: articulaciones. Figuras 66-69. *Abra prismatica*. 66, 67: valvas de 4,5 y 5,2 mm (CAP); 68, 69: detalles de la articulación.
Figures 63-65. *Abra alba*. 63: shell, 6 mm (CAP). 64, 65: hinge. Figures 66-69. *Abra prismatica*. 66, 67: valves of 4.5 and 5.2 mm (CAP); 68, 69: details of the hinges.

Cylichnina crebrisculpta Monterosato, 1884 (Figs. 43-45)

Cylichnina crebrisculpta Monterosato, 1884. *Nom. Gen. e Spec.*: 143.

Material examinado: 6 v, 28 c, Vallcarca, 35/45 m (CAP).

OLIVERIO Y TRINGALI (2991) ilustran dos tipos de esta especie, cuya concha se caracteriza por su perfil oval, su escultura espiral conspicua y microescultura axial formada, además de las líneas de crecimiento, por numerosas costillas minúsculas, rectas y muy apretadas. Se diferencia de *C. laevisculpta* (Granata-Grillo, 1877), redescrita e ilustrada por GAGLINI (1991), en que esta última tiene la concha más pequeña, con un perfil casi cilíndrico, estrecha en su parte central.

Citada por HIDALGO (1917) para aguas profundas de Asturias, se cita aquí por primera vez para el Mediterráneo español y también es común en fondo fangoso-detrítico costero en Vilassar de Mar.

Cylichnina nitidula (Lovén, 1846) (Figs. 46-48)

Cylichna nitidula Lovén, 1846. *Index Moll.*: 10.

Material examinado: 40 v, 75 c, Vallcarca, 45/60 m (CAP); 8 c, "El Turó", 76 m (CAP); 15 v, 35 c, "Cubelles", 90 m (CAP).

GAGLINI (1991) redescribe e ilustra esta especie, diferenciándola de *C. umbilicata* (Montagu, 1803), de la cual se había considerado sinónimo. Se diferencia de ella básicamente en su menor tamaño, en su perfil oval, no cilíndrico, en su espira apenas visible, debido a la estrechez del ombligo, y en la escultura espiral ausente.

HIDALGO (1917) la cita para aguas profundas de Valencia. La nuestra es la segunda cita para el Mediterráneo español.

Ringicula ciommeii Mariottini, Smriglio y Oliverio, 2000

Ringicula ciommeii Mariottini, Smriglio y Oliverio, 2000. *Boll. Malac.*, 36 (5-8): 71-82. [Localidad tipo: Mar Tirreno central, 360-600 m)

En GIRIBET Y PEÑAS (1997) se citaba e ilustraba un juvenil procedente de "El Parruset, 200-450 m, identificado como *R.* cf. *leptocheila*. Según MARIOTTINI, SMRIGLIO Y OLIVERIO (2000), en su revisión del género *Ringicula*, esa concha pertenece a la nueva especie *R. ciommeii*.

Laona sp. (Figs. 49, 50)

Material examinado: 1 c, Vallcarca, 45/60 m (CAP).

Esta frágil concha tiene un parecido con la de *Laona finmarchica* (W. Clark, 1827) pero la de esta última especie tiene microescultura espiral y la protoconcha emerge del perfil de la última vuelta.

Baptopdoris cinnabarina Bergh, 1884 (Fig. 71)

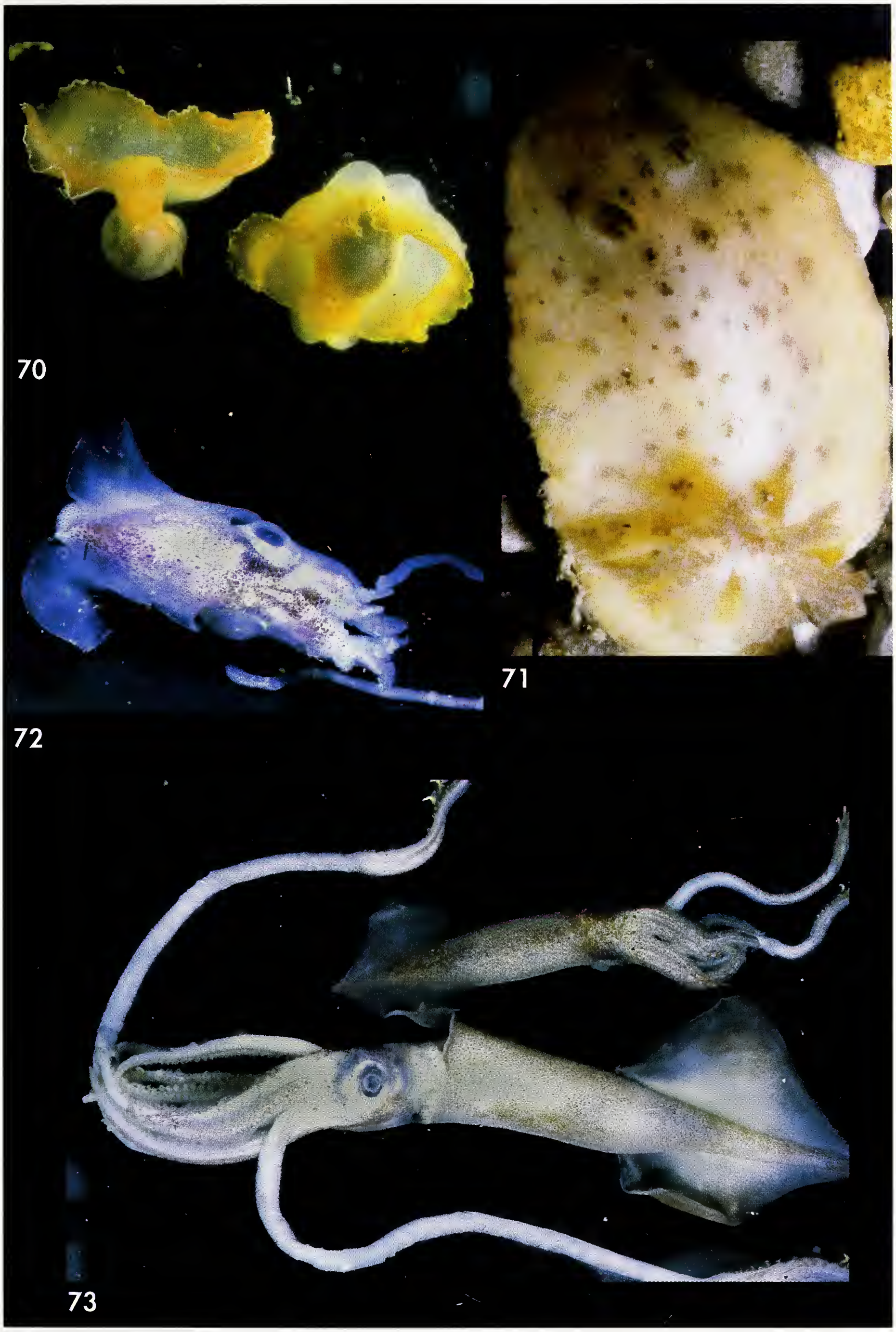


Figura 70. *Gastropteron rubrum.* Figure 71. *Baptodoris cinnabarina.* Figura 72. *Neorossia caroli.* Figura 73. *Ancistroteuthis lichtensteini.*
Figure 70. Gastropteron rubrum. *Figure 71.* Baptodoris cinnabarina. *Figure 72.* Neorossia caroli. *Figure 73.* Ancistroteuthis lichtensteini.

Baptopdoris cinnabarina Bergh, 1884. *Malacologische Untersuchungen*, 2, 3, (15): 671-677, lám. 69, figs 35-36, lám. 70, figs 1-19. [Localidad tipo Trieste, Italia].

Material examinado: 1 ejemplar de 40 mm de longitud recolectado el 24/04/91 en la zona superior (450 m de profundidad) del cañón submarino La Merenguera, frente a la pedanía de Vallcarca.

Este ejemplar, recolectado en la campaña RETRO de la primavera de 1991, fue identificado en aquel momento como *Platydoris maculata* Bouchet, 1977, una especie de nudibranquio doridáceo de profundidad recientemente descrita (Bouchet, 1977). Posteriormente, el estudio de Ballesteros y Valdés (1999) de una serie de ejemplares de doridáceos de similar morfología, procedentes de varios puntos de la plataforma continental ibérica permitió identificarlos con *B. cinnabarina*, una especie muy poco conocida; estos autores redescriben la especie aportando nuevos datos anatómicos e imágenes al microscopio de barrido electrónico (MEB) y registran su presencia por vez primera para la plataforma continental ibérica. Nuestro ejemplar del cañón La Merenguera también fue asignado a *B. cinnabarina*. Desde entonces, este doridáceo ha sido recolectado en más localidades de la plataforma continental catalana (Doménech, Ávila y Ballesteros, 2006). La especie europea de profundidad del género *Platydoris*, *P. maculata* Bouchet, 1977 ha sido propuesta recientemente (Dorgan, Valdés y Gosliner, 2002) como sinónimo de *Baptodoris cinnabarina*.

Limatula cf. *bisecta* Allen, 2004 (Figs. 51, 52)

Limatula cf. *bisecta* Allen, 2004. *Tour. Nat. Hist.*, 38: 2591-2653. [Localidad tipo: SW Irlanda (52° 21,1′ N, 12° 07,4′ W), 479 m].

Nuevo material examinado: 2 valvas completas y 2 fragmentos, "Cubelles", 90 m (CAP).

En Giribet y Peñas (1977) se citaba el hallazgo de una valva casi lisa, muy frágil, procedente del caladero "El Parruset", entre 200 y 450 m de profundidad, identificada como *Limatula* cf. *gwyni* (Sykes, 1903). Peñas y Giribet (2003) citan 3 valvas de la misma especie en el caladero "Mar de Nacra", a 105 m, como *Limatula* sp. Ese material y el nuevamente examinado parece coincidir con la nueva especie descrita por Allen (2004) para aguas profundas del suroeste de Irlanda: concha semitransparente, de extrema fragilidad, igual relación H/D y escultura apenas marcada.

Montacuta sp. (Figs. 60-62)

Material examinado: 3 valvas, "Cubelles", 90 m (CAP).

Esta especie parece un juvenil de *Montacuta ferruginosa* (Montagu, 1808) ya que tiene una zona angulosa en el borde dorsal posterior y muy parecida la posición de los dientes cardinales; sin embargo, es más sólida, tiene una forma menos elíptica, con una relación H/D= 1.5, frente a 1.7 en *M. ferruginosa*, y el margen interior es crenulado.

Sportella sp. (Figs. 53-59)

Material examinado: 1 ejemplar vivo, Vallcarca, 45/60 m, fondo detrítico fangoso (CAP).

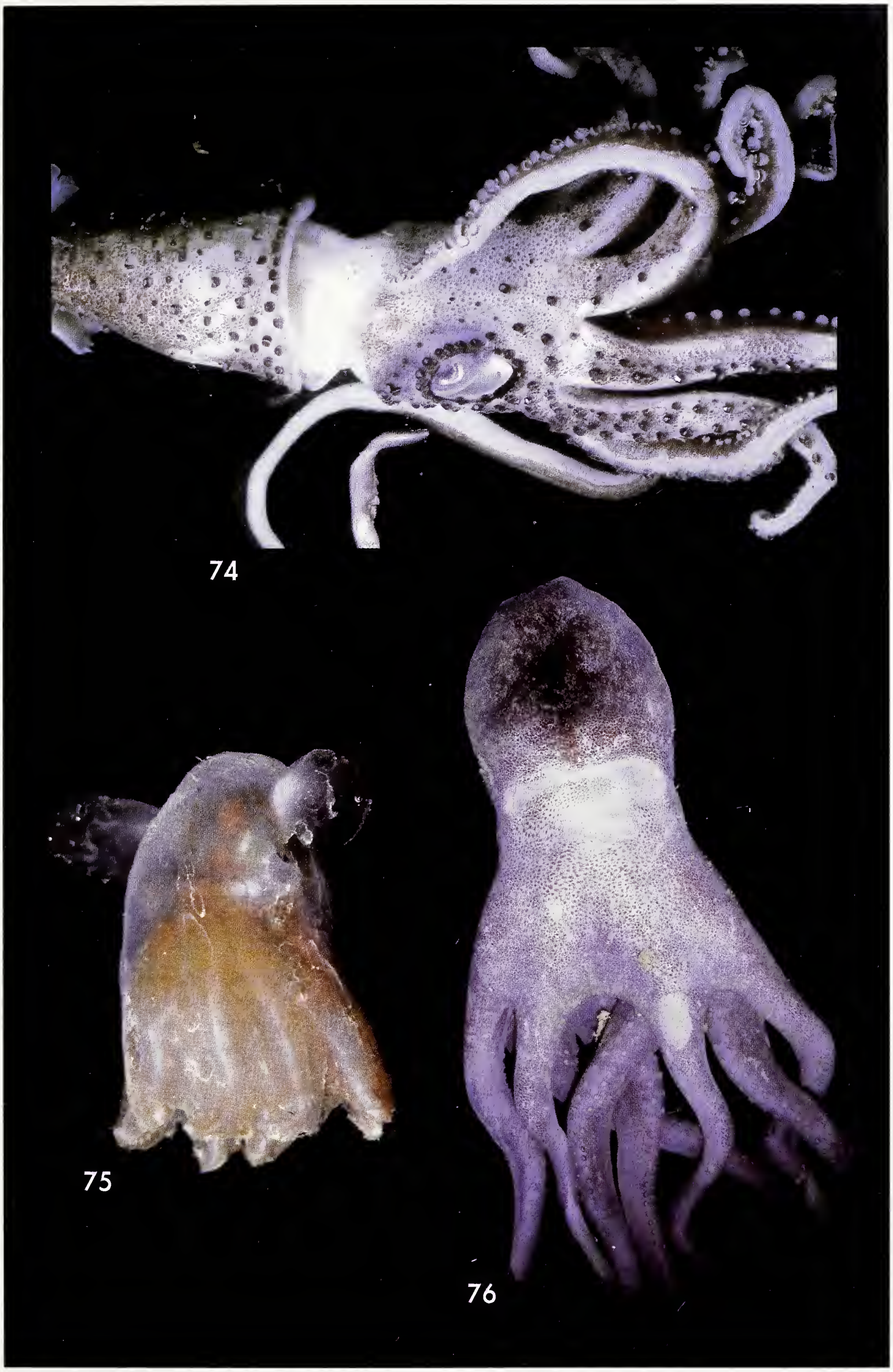


Figura 74. *Histioteuthis reversa.* Figura 75. *Opisthoteuthis* sp. Figura 76. *Bathypolypus sponsalis.*
Figure 74. Histioteuthis reversa. *Figure 75.* Opisthoteuthis *sp. Figure 76.* Bathypolypus sponsalis.

El ejemplar encontrado es adulto y mide 10.6 x 7 mm. Tiene un periostraco ferruginoso, relativamente grueso, brillante, muy rojizo en su zona umbonal. Las valvas son sólidas de color blanco, opacas, apenas brillantes. Las líneas de crecimiento son conspicuas. Esta especie tiene en la forma un gran parecido con *Montacuta voeringi* Friele 1877, cuyo tipo ilustra AARTSEN (1996), también citada e ilustrada por GAGLINI (1992) como *M. cuneata*, pero las escasas valvas conocidas de esta especie son frágiles y mucho más pequeñas, tienen el umbo más desplazado hacia el lado posterior y la charnela es diferente, con un solo diente cardinal.

Provisionalmente se ubica en el género *Sportella* por el parecido de su charnela con *S. recondita* (Fischer, 1872), sin embargo la forma de las valvas es diferente: *S. recondita* las tiene equiláteras, casi rectangulares. El ejemplar ilustrado en AARTSEN (1996: figs. 24L y 24R) mide 9 x 5 mm, con una relación H/D= 1.8, frente a 1.5 en *Sportella* sp. También la microescultura externa difiere: es claramente granulosa en *S. recondita*.

CONCLUSIONES

Este nuevo trabajo reafirma lo constatado en los anteriores referidos al Garraf: la gran riqueza malacológica de las aguas de esta pequeña comarca, en buena medida debido a la variedad de sus fondos. Hasta la fecha se han citado para esta pequeña comarca 746 especies de moluscos marinos (4 caudofaveata, 1 solenogastre, 7 poliplacóforos, 497 gasterópodos, 213 bivalvos, 8 escafópodos y 16 cefalópodos). De ellas, 61 han sido primera cita para el Mediterráneo español; y se han descrito cinco nuevas especies para la ciencia: *Epilepton parrusetensis*, *Bathycrinicola nacraensis*, *Alvania garrafensis*, *Bela clarae* y *Chysallida dantarti*.

También se puede afirmar, que ésta es la zona del Mediterráneo español más exhaustivamente estudiada hasta la fecha, y quizá la más rica en moluscos marinos junto con la isla de Alborán y su plataforma continental, tras el trabajo de PEÑAS, ROLÁN, LUQUE, TEMPLADO, MORENO, RUBIO, SALAS, SIERRA Y GOFAS (2006).

La nueva lista faunística de los moluscos marinos del Garraf enriquece aún más los conocimientos que se poseen sobre la malacofauna catalana. En el módulo de moluscos (Molluscat) del Banc de Dades de Biodiversitat de Catalunya (BIOCAT) (BALLESTEROS, 2007a) aparecen un total de 1909 especies válidas de moluscos marinos, continentales y dulceacuícolas registrados en Cataluña, de los cuales 1 es un monoplacóforo, 18 son poliplacóforos, 8 son escafópodos, 303 son bivalvos, 1549 son gasterópodos y 30 son cefalópodos. Las especies de caudofoveados y solenogastros, que aparecen en la Tabla I, y que fueron recolectados en la campaña RETRO en el cañón La Merenguera, resultaron ser la primera cita de aplacóforos para las costas catalanas. Recientemente (BALLESTEROS, 2007b) se ha publicado una lista actualizada de los opistobranquios citados en las costas catalanas, registrándose un total de 205 especies de este grupo de gasterópodos. Todo ello contribuye a que la malacofauna de Cataluña se halle entre las mejor conocidas de las áreas geográficas de la Península Ibérica y de Europa.

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Systematics and distribution of shelled molluscs (Gastropoda, Bivalvia and Scaphopoda) from the South Shetland Islands to the Bellingshausen Sea, West Antarctica

Sistemática y distribución de los moluscos con concha (Gastropoda, Bivalvia y Scaphopoda) desde las Islas Shetland del Sur al Mar de Bellingshausen, Antártica Oeste

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ABSTRACT

The knowledge of the systematics and distribution of molluscs from the area of West Antarctica, mainly of the Bellingshausen Sea, remains relatively poor. Only 3 families and 11 species of molluscs were recorded in the Bellingshausen Sea, while 2 families and 3 species were recorded from Peter I Island. This apparently low number of species is the result of poor sampling in this area. An integral study of the benthic ecosystem was carried out in this area by the Spanish Antarctic Program: BENTART research cruises during the austral summer season in 2003 and 2006 on the continental shelf and lower slope from 53 to 3304 metres. A total of 3133 individuals belonging to 118 species of shelled molluscs were identified, of which 571 individuals corresponding to 71 species of gastropods, 2200 individuals to 42 species of bivalves and 362 individuals to 5 species of scaphopods. *Neobuccinum eatoni* with 89 individuals, *Genaxinus debilis* with 674 individuals and *Dentalium majorinum* with 159 individuals were the most abundant species of gastropods, bivalves and scaphopods, respectively. Of the total cited species, six new records are added for the South Shetland Islands, 30 for the Western Antarctic Peninsula, 34 for the Bellingshausen Sea and 30 for Peter I Island. On the other hand, new bathymetric records are given for 44 species in Antarctic waters.

RESUMEN

El conocimiento de la sistemática y distribución de moluscos en la Antártica Oeste, mayormente en el área del Mar de Bellingshausen es aun pobre. Sólo 3 familias y 11 especies de moluscos han sido registradas en el Mar de Bellingshausen, así como 2 familias y 3 especies en el área de la Isla Pedro I. Este aparentemente bajo número de especies es el resultado de una baja cantidad de muestreos. Un estudio integral de los ecosistemas bentónicos fue llevado a cabo en esta área por el Programa Antártico Español: los Cruceros de Investigación BENTART, durante los veranos australes del 2003 y 2006 sobre la plataforma continental y talud entre 53 y 3304 m. Fueron identificados un total de 3133 individuos pertenecientes a 118 especies de moluscos con concha, de los cuales 571 individuos corresponden a 71 especies de gasterópodos, 2200 individuos a 42 especies de bivalvos y 362 individuos a 5 especies de escafópodos. *Neobuccinum eatoni* con 89

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individuos, *Genaxinus debilis* con 674 individuos y *Dentalium majorinum* con 159 individuos son las especies más abundantes de gasterópodos, bivalvos y escafópodos, respectivamente. Del total de especies registradas se aportan 6 nuevos registros para las Islas Shetland del Sur, 30 para el Oeste de la Península Antártica, 34 para el Mar de Bellingshausen y 30 para la Isla Pedro I. En tanto se amplían los registros batimétricos conocidos en la Antártica para 44 especies.

Key Words: Molluscs, Gastropods, Bivalves, Scaphopods, systematics, distribution, West Antarctica, Bellingshausen Sea.
Palabras Clave: Moluscos, Gastrópodos, Bivalvos, Escafópodos, sistemática, distribución, Antártica Oeste, Mar de Bellingshausen.

INTRODUCTION

Knowledge of molluscs in the Southern Ocean started to build up towards the end of the XIX century with the H.M.S. Challenger expedition (1873-1876) which visited several Sub-Antarctic islands. The expedition results were published in the works of SMITH (1885) for bivalves and that of WATSON (1886) for gastropods and scaphopods. The "Venus" Expedition carried out in 1874-1875 gave the first report on molluscs from the Kerguelen Islands (Smith 1879). Years later, the "Belgian Antarctic Expedition (1897-1899)" was focused on the Antarctic continent, particularly on the South Shetland Islands and towards the West of the Antarctic Peninsula and culminated with the publication of the works of PELSENEER (1903) and PLATE (1908a). The British Expedition "Southern Cross" (1898-1900) simultaneously explored the Ross Sea and Macquarie Island and reported new species in SMITH (1902), while the German "Deutsche Tiefsee-Expedition (1898-1899)" to the Kerguelen and Bouvet Islands generated new reports that were published by THIELE AND JAECKEL (1931). One year later, the German "Deutsche Südpolar-Expedition" in 1901-1903 focused on the Davis Sea, from which many species were reported by PLATE (1908b) for Scaphopoda and by THIELE (1912) for Gastropoda and Bivalvia.

Other expeditions from the time were the "Schwedische Südpolar-Expedition" to several Sub-Antarctic Islands in 1901-1903, the British National Antarctic Expedition "Discovery" to the Ross Sea and Macquarie Island in 1901-1904 and the "Scottish National Antarctic Expedition" to Scotia Arc Islands in 1902-1904, resulting in the contributions of STREBEL (1908), SMITH (1907) and MELVILL AND STANDEN (1907, 1912), respectively. Other parallel expeditions were the "Expédition Antarctique Française" in 1903-1905 and the "Deuxième Expédition Antarctique Française" in 1908-1910, which obtained new samples on numerous sites close to the Antarctic Peninsula, their results being reported in several works (e.g. LAMY, 1906b, 1911a). Subsequently, the British Antarctic Expedition "Terra Nova" in 1910-1913, researched the Ross Sea and adjacent zones/areas and resulted in the publication of the works of SMITH (1915) and EALES (1923). The "Australian Antarctic Expedition (1911-1914)" was focused on the Eastern Antarctic and new species were cited by HEDLEY (1916).

Research came to a standstill from this date until 1926-1937, when the "Discovery Expeditions" generated important reports and inventories on molluscs from several Sub-Antarctic Islands, the Antarctic Peninsula coast and the Ross Sea (POWELL, 1951; DELL, 1964). Meanwhile, other surveys like the "Norwegian Antarctic Expedition (1927-1930)" explored the Western Peninsula and other sites and resulted in a work on Bivalvia by SOOT-RYEN (1951). The British, Australian and New Zealand

Antarctic Expedition (B.A.N.Z.: 1929-1931) provided a detailed knowledge of the Ross Sea, Enderby Land and the Sub-Antarctic Islands of East Antarctica through the works of POWELL (1957, 1958). All records and earlier reports were summarized by POWELL (1960).

Later, the works of EGOROVA (1972, 1982) communicated the results of many Soviet expeditions held from 1955 onwards mainly to the Davis Sea. The new French expeditions to Terre Adélie (e.g. ARNAUD, 1972, 1973) and the Japanese expeditions to East Antarctica published their records in several works (e.g. OKUTANI, 1986: NUMANAMI AND OKUTANI, 1991; NUMANAMI 1996; NUMANAMI, OKUTANI, IWAMI, TAKEUCHI, IGARASHI, TSUCHIYA AND FUKUCHI, 1996). The last known extensive works are those of DELL (1990) and HAIN (1990). Dell focused mainly on the Ross Sea and reported species collected from several surveys, principally from the US "Eltanin" cruises but he also examined samples from some previous expeditions that were deposited in zoological museums. Hain reported many species from the Weddell Sea that were collected in some German "Antarktis"expeditions.

Apart from the abovementioned expeditions held towards the end of the XX and the beginning of the XXI Centuries, detailed information is now available by means of reports with biogeographical analyses on enclosed areas (see ZELAYA, 2005; LINSE 2006), review of particular taxa (e.g. CERNOHORSKY, 1977; PONDER, 1983; OLIVER AND PICKEN, 1984; HARASEWYCH AND KANTOR, 1999) and descriptions of new species (e.g. ENGL, 2004b; DIAS PASSOS AND DOMANESCHI, 2006).

From a biogeographic point of view, the earlier studies of the Southern marine fauna resulted in the definition of the different subregions. There is a latitudinal division into an Antarctic/high Antarctic zone and Sub-Antarctic/low Antarctic zone, and a longitudinal division into East and West Antarctica (POWELL, 1951). The West Antarctica represents one of the most interesting Antarctic areas from both ecological/biogeographical and taxonomical points of view because sample coverage is still extremely patchy. Areas such as the South Shetland Islands and the Western Antarctic Peninsula have been extensively sampled whereas areas such as the Bellingshausen Sea still remains poorly sampled (CLARKE, GRIFFITHS, LINSE, BARNES AND CRAME, 2007).

There are approximately 895 species of gastropods and 379 species of bivalves that are currently known in the Southern Ocean and adjacent regions (LINSE, GRIFFITHS, BARNES AND CLARKE, 2006), and some are exclusive to the Southern Ocean. CLARKE, ARONSON, CRAME GILI AND BLAKE (2004) mentioned approximately 530 gastropod and 110 bivalve species. Only 3 families and 11 species of molluscs were recorded in the Bellingshausen Sea, while 2 families and 3 species were recorded in Peter I Island. This apparently low number of species is the result of poor sampling in this area: two samples were taken on the continental shelf (1-1000 m), zero on the continental slope (1000-3000 m) and six deeper (>3000 m) ones were obtained in the Bellingshausen and Amundsen seas. A total of 1624 samples were taken from the Southern Ocean (CLARKE *ET AL*., 2004), of which 1490 were from the continental shelf, 98 were taken from the continental slope and 36 were from deeper waters.

Therefore, knowledge of the biodiversity of the area of West Antarctica, mainly of the Bellingshausen Sea, and in particular of subtidal marine habitats, remains relatively poor, except for the South Shetland Islands (e.g. Arnaud, Troncoso and Ramos, 2001). Also, there is an important dispersion of literature available for the identification of molluscs from this area. An integral study of the benthic ecosystem: BENTART program was carried out in this area by means of two research cruises during the austral summer season in 2003 and 2006, which were organized and supported by the Spanish Antarctic Program of the Ministry of Education and Science (MEC). This report describes the results of the survey of subtidal marine molluscs and this paper briefly de-

scribes and illustrates the species obtained during the BENTART 2003 and 2006 research cruises to facilitate future marine research in this part of the Southern Ocean.

MATERIAL AND METHODS

The study area was located in West Antarctica from the South Shetland Islands (63º 03′ S, 60º 38′ W) to the Bellingshausen Sea off Thurston Island (70º 53′ S, 98º 26′ W) on the border of the Amundsen Sea (Fig. 1), and included the continental shelf and lower slope from 53 to 3304 metres. Additional samples were taken in shallow waters (5-8 m) by means of SCUBA diving (Table I). Samples were obtained in the austral summer during the BENTART 2003/2006 cruises aboard the vessel BIO *Hespérides* belonging to the Spanish Navy. The molluscs were collected from 47 sampling sites using six sampling gears: a box-corer with a maximum breakthrough of 60-cm and an effective sampling area of 30 x 20 cm, an Agassiz trawl (width-2.01m, height-1.12m and a mesh size of 10.0mm), an epibenthic sledge that consists of a rectangular steel frame with three levels (width-0.8m, heighth-0.4m and an attached mesh net), a rock dredge with 0.8 m wide, 0.3 m height, and a mesh size of 10.0 mm, a Nassa trap designed to catch scavenger organisms, and SCUBA diving in shallow water. Samples were sorted on deck and fixed in borax-buffered 4% formaldehyde in seawater. Later, in the laboratory, they were sorted by species and transferred to plastic vials with 70% alcohol for preservation. All specimens were identified to species level, considering shell features and morphometric ratios compared with similar species. Taxonomic classification follows Ponder and Lindberg (1997) and Rosenberg (2005) for Gastropoda, Giribet and Wheeler (2002) and Rosenberg (2005) for Bivalvia and Steiner and Kabat (2001, 2004) for Scaphopoda. The specimens were deposited in the scientific collection of the Animal Ecology and Biology of Universidad de Vigo, Spain.

For each species, the systematic description and synonymies are given. This includes the reference to the original description and subsequent systematic works that were used for identification. The studied material was detailed by stations as number of live collected specimen/s (spm.) and fresh empty shell/s (sh.) and the measurements of the larger and smaller specimens were included. Measurements for gastropods refer to maximum height from apex to basis and diameter (width, perpendicular to height); for bivalves, maximum height from umbo to ventral margin and width from anterior to posterior margins, and for scaphopods, longitude and diameter of anterior and posterior apertures. The stations were named MB for Bellingshausen Sea, PI for Peter I Island, PA for Antarctic Peninsula, LOW for Low Island, DEC for Deception Island, and MAR for Margarita Bay.

All figured specimens are from this survey and were obtained using digital photography or Scanning Electron Microscopy (SEM) at the University of Vigo. The geographic and bathymetric distributions are given taking account of all taxonomical and biogeographical works revised, and also including the records of this study, and marking as "new record/s" the species occurring for the first time in the study area. The geographic locations are shown in Figure 1.

(Right page) Figure 1. Study area, stations of benthic samples from BENTART and locations around Antarctica mentioned in text. MB: stations of Bellingshausen Sea, PI: Peter I Island, PA: Antarctic Peninsula, LOW: Low Island, DEC: Deception Island, and MAR: Margarita Bay.

(Página derecha) Figura 1. Área de estudio, estaciones de muestreos bentónicos de BENTART y lugares alrededor de la Antártica mencionados en el texto. MB: estaciones del Mar de Bellingshausen, PI: Isla Pedro I, PA: Península Antártica, LOW: Isla Low, DEC: Isla Decepción, y MAR: Bahía Margarita.

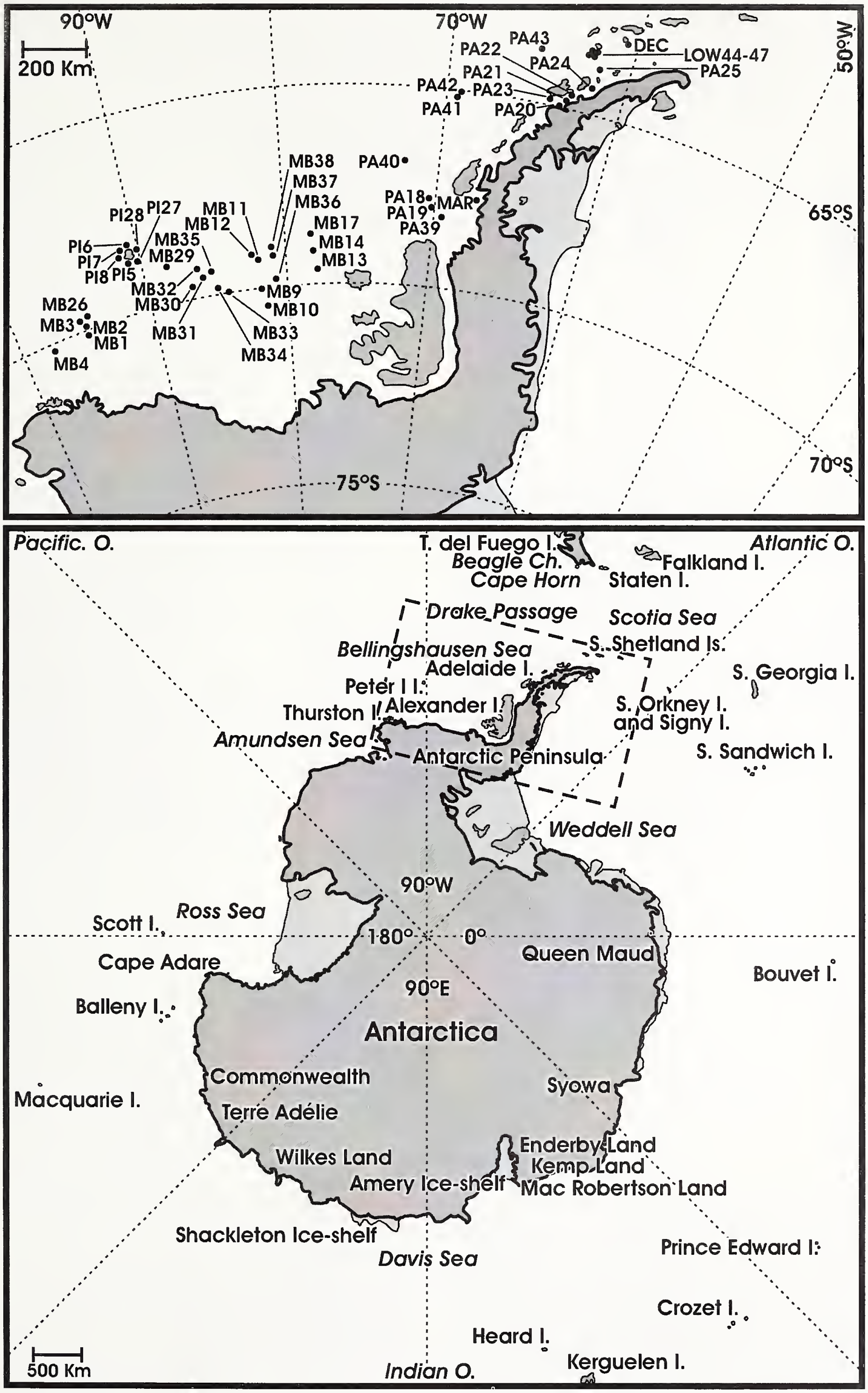

90°W
200 Km
70°W
50°W
65°S
70°S
75°S
PA43
PA22
DEC
LOW44-47
PA24
PA25
PA21
PA42
PA23
PA41
PA20
MB38
PA40
MB37
MB36
PA18
MAR
PA19
PA39
PI28
PI27
MB11
MB12
MB17
MB35
MB14
PI6
MB29
MB13
PI7
PI8
PI5
MB32
MB9
MB30
MB10
MB26
MB3
MB2
MB1
MB31
MB33
MB34
MB4
Pacific. O.
T. del Fuego I.
Atlantic O.
Beagle Ch.
Falkland I.
Cape Horn
Staten I.
Drake Passage
Scotia Sea
Bellingshausen Sea
S. Shetland Is.
Adelaide I.
S. Georgia I.
Peter I I.
Thurston I.
Alexander I.
S. Orkney I.
and Signy I.
Amundsen Sea
Antarctic Peninsula
S. Sandwich I.
Weddell Sea
90°W
Ross Sea
Scott I.
180°
0°
Queen Maud
Cape Adare
90°E
Bouvet I.
Balleny I.
Antarctica
Commonwealth
Syowa
Macquarie I.
Terre Adélie
Enderby Land
Wilkes Land
Kemp Land
Amery Ice-shelf
Mac Robertson Land
Shackleton Ice-shelf
Davis Sea
Prince Edward I.
Crozet I.
Heard I.
500 Km
Indian O.
Kerguelen I.

Table I. Location, depth and sample device of survey stations, named MB for Bellingshausen Sea, PI for Peter I Island, PA for Antarctic Peninsula, LOW for Low Island, DEC for Deception Island, and MAR for Margarita Bay. AT: Agassiz trawl, BC: Box-corer, RD: Rock dredge, ES: Epibenthic sledge, NT: Nassa trap, SD: Scuba diving.

Tabla I. Ubicación, profundidad y arte de muestreo de las estaciones, nombradas como MB para el Mar de Bellingshausen, PI para la Isla Pedro I, PA para la Península Antártica, LOW para la Isla Low, DEC para la Isla Decepción, y MAR para Bahía Margarita. AT: Red Agassiz, BC: Box-corer, RD: Draga de roca, ES: Trineo suprabentónico, NT: Nassas, SD: Buceo Scuba.

Station	Latitude S	Longitude W	Depth (m)	Sample device
MB1	70° 38.22'	95° 15.36'	534	AT, BC
MB2	70° 29.25'	95° 14.83'	780	AT, BC
MB3	70° 17.58'	95° 11.86'	1431	AT, BC
MB4	70° 52.86'	98° 26.12'	425	AT, BC
PI5	68° 56.70'	90° 35.70'	126	AT, BC, RD, ES
PI6	68° 49.61'	90° 48.78'	210	AT, BC, NT
PI7	68° 42.20'	90° 40.80'	410	AT, BC
PI8	68° 50.18'	90° 51.08'	90	AT, BC, NT
MB9	70° 14.40'	81° 47.03'	532	AT, BC
MB10	70° 44.31'	81° 27.85'	497	BC
MB11	69° 27.07'	82° 06.76'	1289	AT, BC
MB12	69° 24.27'	82° 11.88'	2032	BC
MB13	69° 49.56'	77° 43.68'	605	AT, BC, NT, ES
MB14	69° 21.12'	78° 04.91'	498	BC, ES
MB17	68° 54.88'	78° 14.16'	2044	AT, BC
PA18	67° 57.31'	71° 04.70'	354	AT
PA19	68° 04.13'	70° 52.38'	513	AT
PA20	65° 01.03'	63° 25.25'	53	AT, NT
PA21	64° 54.01'	63° 01.11'	107	AT, BC
PA22	64° 50.58'	62° 57.91'	294	AT, BC
PA23	64° 55.95'	63° 38.40'	655	AT, BC
PA24	64° 20.11'	61° 58.82'	1056	AT, BC
PA25	63° 52.85'	61° 48.52'	110	AT, BC
MB26	70° 14.62'	95° 02.20'	1920	AT, BC
PI27	68° 59.20'	90° 26.60'	1873	ES
PI28	68° 52.31'	90° 18.80'	1191	ES, AT
MB29	69° 26.08'	88° 26.17'	3304	AT
MB30	69° 58.98'	87° 31.08'	1814	AT, BC
MB31	69° 56.98'	86° 19.27'	1426	AT, BC, ES
MB32	69° 47.60'	86° 27.33'	1847	AT
MB33	70° 15.90'	84° 11.45'	438	BC, ES
MB34	70° 08.20'	84° 51.68'	603	AT, BC, ES
MB35	69° 56.03'	85° 11.30'	1117	AT, BC, ES
MB36	69° 56.28'	80° 24.55'	560	AT, BC, ES
MB37	69° 26.38'	80° 51.62'	495	AT, BC
MB38	69° 14.08'	80° 61.20'	1324	AT, BC, ES
PA39	68° 07.62'	69° 36.20'	157	AT, ES
PA40	66° 57.55'	72° 34.97'	402	AT
PA41	65° 28.29'	69° 01.71'	350	ES
PA42	65° 09.99'	68° 56.18'	1272	ES
PA43	63° 21.71'	64° 17.68'	254	ES
LOW44	63° 25.81'	62° 12.23'	82	AT
LOW45	63° 25.90'	62° 12.69'	86	AT
LOW46	63° 26.22'	62° 14.70'	97	AT
LOW47	63° 28.01'	62° 12.91'	115	AT
DEC	63° 03.00'	60° 36.60'	60-80	AT
MAR	68° 04.20'	67° 34.80'	5-8	SD

RESULTS

Class GASTROPODA Cuvier, 1797
Subclass EOGASTROPODA Ponder and Lindberg, 1996
Order PATELLOGASTROPODA Lindberg, 1986
Family NACELLIDAE Thiele, 1891
Genus *Nacella* Schumacher, 1817

Nacella polaris concinna (Strebel, 1908) (Fig. 2)

Nacella polaris var. *concinna* Strebel, 1908: 82, pl. 5, figs. 76a-e, 78a-b.
Patinigera polaris concinna: Powell, 1951: 83; Castellanos and Landoni, 1988: 26, pl. 4, fig. 5.
Nacella cf. *concinna*: Hain, 1990: 36, fig. 4.1.
Lepeta depressa Hedley, 1916: 42, pl. 6, fig. 64; Arnaud, 1972: 114; Dell, 1972: 32, figs. 19, 24-25; Egorova, 1982: 14, fig. 75.

Material studied: 16 spm. (9.0 x 6.1 - 29.6 x 20.5 mm), PA20; 1 spm. (10.4 x 7.1 mm), PA21.

Remarks: Although morphologic variation is present, only two morphotypes have been cited that separate this subspecies of *Nacella polaris polaris* (HOMBRON AND JAQUINOT, 1841). POWELL (1951) described *N. polaris concinna* as an endemic species from deep water around South Georgia, but BEAUMONT AND WEI (1991) studied the morphologic variation between specimens from South Georgia and the South Orkney Islands and concluded that it was a single species and not a separate subspecies. However, these specimens can be differentiated from the subspecies *N. polaris polaris* because they are paler, thinner and have a more central umbo and stronger radial ribs. There is also a bathymetric pattern between both subspecies since *N. polaris concinna* can be found at greater depths.

Distribution: Weddell Sea (Hain, 1990), South Georgia (POWELL, 1951; STREBEL, 1908), South Orkney and South Shetland Islands (CASTELLANOS AND LANDONI, 1988), Western Antarctic Peninsula (CARCELLES, 1953; this study), Ross Sea (DELL, 1972), Terre Adélie (ARNAUD, 1972), Shackleton Ice Shelf (HEDLEY, 1916) and Davis Sea (EGOROVA, 1982); from 10 m (STREBEL, 1908) to 695 m (DELL, 1972).

Nacella polaris polaris (Hombron and Jaquinot, 1841) (Fig. 3)

Patella polaris Hombron and Jaquinot, 1841: 191.
Nacella aenea var. *polaris*: Pelseneer, 1903: 14.
Nacella polaris: Lamy, 1906b: 10; 1911a: 15; 1911b: 26; Zelaya, 2005: 111, fig. 2.
Patella polaris: Martens and Pfeffer, 1886: 101, pl. 2, figs. 11-13; Melvill and Standen, 1907: 127.
Patinella polaris: Strebel, 1908: 81, pl. 5, figs. 77a-b, 79-82.
Patinigera polaris polaris: Powell, 1951: 82; Castellanos and Landoni, 1988: 25, pl. 4, fig. 8.

Material studied: 12 spm. (7.8 x 5.1 - 55.8 x 41.8 mm), MAR.

Remarks: Smallest specimens look similar to *N. polaris concinna* (Strebel, 1908), but they can be differentiated by their darker, thicker and smoother shell, with more anterior umbo. Powell (1951) reported *N. polaris polaris* as a shallow water species, occurring in Antarctica and Scotia Arc Islands.

Distribution: South Sandwich (LAMY, 1911b) and South Georgia Islands (MARTENS AND PFEFFER, 1886; STREBEL, 1908, LAMY, 1911b; POWELL, 1951; ZELAYA, 2005), reaching 38°S in the Atlantic Ocean (CASTELLANOS AND LANDONI, 1988), cited in the Weddell Sea as well (ZELAYA, 2005), East of the Antarctic Peninsula (STREBEL,

1908), South Orkney (Pelseneer, 1903; Melvill and Standen, 1907; Powell, 1951) and the South Shetland Islands (Powell, 1951), West of the Antarctic Peninsula (Lamy, 1906b, 1911a; Powell, 1951; this study), also in Bouvet Island (Powell, 1951); from 0 m (Powell, 1951) to 195 m (Strebel, 1908).

Family Lepetidae Dall, 1869
Genus *Iothia* Gray, 1857

Iothia coppingeri (Smith, 1881) (Fig. 4)

Tectura coppingeri Smith, 1881: 35, pl. 4, figs. 12, 12a.
Pilidium coppingeri: Strebel, 1908: 83.
Tectura coppingeri: Rochebrune and Mabille, 1889: 90.
Lepeta coppingeri: Thiele, 1912: 183, 233; Smith, 1915: 62; Hedley 1916: 41; Eales, 1923: 6; Powell, 1951: 84; Powell, 1957: 128; 1958: 184; Arnaud, 1972: 114, fig. 1 (radula); Castellanos and Landoni, 1988: 32, pl. 1, fig. 6, pl. 3, fig. 9; Linse, 1997: 27.
Iothia coppingeri: Egorova, 1982: 12, figs. 25 (radula), 73-74; Dell, 1990: 105, figs. 185-186; Hain, 1990: 37, pl. 1, figs. 4a-c, pl. 17, fig. 4; Numanami *et al.*, 1996: 212 (table, text), pl.1, figs. 3-4; Reid and Osorio, 2000: 119, fig. 7A; Troncoso, Van Goethem and Troncoso, 2001: 90, fig. 8. (conferred); Zelaya, 2005: 112, fig. 3.
Patella (?) emarginuloides Philippi, 1868: 224.
Lepeta antarctica Smith, 1907a: 12, pl. 2, figs. 11-11a; Hedley, 1911: 4.
Pilidium fulviformes Egorova, 1972: 384, figs. 3a-b.

Material studied: 1 spm. (6.1 x 4.5 mm), PA19; 1 spm. (5.7 x 4.1 mm), PA22.

Remarks: Its synonymies are validated in previous works (Dell, 1990). Linse (2002, p. 56) described *Iothia coppingeri magellanica* in Magellanic waters; but her figures 9.1.1 1-4 from plate I are confused in their captions and repeated in plate X.Therefore the comparison with Linse's subspecies is not possible.

Distribution: Circumantarctic and Sub-Antarctic. South Georgia (Zelaya, 2005), South Orkney (Dell, 1990) and the Falkland/Malvinas Islands (Strebel, 1908; Powell, 1951), Cape Horn (Rochebrune and Mabille, 1889), Beagle Channel (Linse, 1997) and Punta Arenas (Powell, 1951), also in Staten Island, Magellan Strait, reaching Valdivia (38° S) in the South Pacific (Dell, 1990). In Antarctica in the Weddell Sea (Dell, 1990; Hain, 1990), South Shetland Islands, Western Antarctic Peninsula (Dell, 1990; this study), the Ross Sea (Smith, 1907a; Hedley, 1911; Powell, 1951; Dell, 1990), Commonwealth (Hedley, 1916; Powell, 1958), Terre Adélie (Arnaud, 1972) and Wilkes Land (Dell, 1990), the Davis Sea (Thiele, 1912; Egorova, 1982; Dell, 1990), Kerguelen Islands (Powell, 1957; Troncoso *et al.*, 2001), Crozet Islands (Powell, 1957), Enderby Land (Powell, 1958) and Syowa (Numanami *et al.*, 1996); from 5 m (Egorova, 1982) to 1108 m (Hain, 1990).

Subclass Orthogastropoda Ponder and Lindberg, 1996
Superorder Vetigastropoda Salvini-Pläwen, 1980
Family Anatomidae McLean, 1989
Genus *Anatoma* Woodward, 1859

Anatoma euglypta (Pelseneer, 1903) (Fig. 5)

Scissurella euglypta Pelseneer, 1903: 17, 38, pl. 4, figs. 43-45; Thiele, 1912: 187; Melvill and Standen, 1912: 345.

Schizotrochus euglyptus: Powell, 1951: 79; Powell, 1958: 179; Arnaud, 1972: 113; Egorova, 1982: 11, fig. 72; Castellanos and Landoni, 1988: 9, pl. 1, fig. 7.
Anatoma euglypta: Dell, 1990: 75, fig. 129; Hain, 1990: 33, pl. 1, fig. 1, pl. 17, fig. 1 (radula); Numanami and Okutani, 1990a: 94, figs. 2-5; Branch, Arnaud, Cantera and Gianakouras, 1991: 58 (key); Numanami, 1996: 13, figs. 6A-C, D (radula); Zelaya, 2005: 12, fig. 5; Zelaya and Geiger, 2007: 399, figs, 16-40, 41-47, 50 (anatomy), 48-49 (radula).

Material studied: 2 spm. (broken), MB2; 2 spm. (2.4 x 3.0 - 2.9 x 3.6 mm), MB31; 2 spm. (2.1 x 2.8 - 2.1 x 2.9 mm), MB33; 1 spm. (4.8 x 5.6 mm), MB34; 2 spm. (2.6 x 3.3 - 4.1 x 4.8 mm), MB35; 3 spm. (2.5 x 3.5 - 4.8 x 6.1 mm), MB38; 1 spm. (1.1 x 1.7 mm), PA39; 1 spm. (0.8 x 1.2 mm), PA41; 2 spm. (1.9 x 2.5 - 2.9 x 3.8 mm), PA42.

Remarks: Other similar species are *A. conica* (d'Orbigny, 1841), which is proportionally higher and has only a Magellanic distribution (DELL, 1990), and *A. shiraseae* Numanami and Okutani, 1990 which differs in having a keel on the shoulder, a distinctive constriction below the selenizone, and a coarser sculpture. *Thieleella amoena* (Thiele, 1912) is more globose with a stronger selenizone; *T. weddelliana* Zelaya and Geiger, 2007 has a globular instead of a biconical last whorl, and stronger axial sculpture. Also, this species has affinity in contour and sculpture with the northern hemisphere species, *A. crispata* (Fleming, 1828), cited by WATSON (1886) from Prince Edward Island, but it is a higher and larger species with shorter selenizone.In this sense, ZELAYA AND GEIGER (2007) in the revision of the group, found some of Watson's specimens named *A. crispata*, which actually correspond to *A. euglypta*.

Distribution: Weddell Sea (DELL, 1990; HAIN 1990; ZELAYA AND GEIGER, 2007), South Sandwich (ZELAYA AND GEIGER, 2007), South Georgia (POWELL, 1951; ZELAYA, 2005), South Orkney Islands (DELL, 1990) and Discovery Bank (60° 08′ S, 34° 56′ W) (ZELAYA AND GEIGER, 2007), reaching Burdwood Bank (MELVILL AND STANDEN, 1912; ZELAYA AND GEIGER, 2007), Staten Island (ZELAYA AND GEIGER, 2007), Cape Horn (DELL, 1990), Drake Passage (56° 19′ S, 67° 09′ W) (ZELAYA AND GEIGER, 2007), and South Atlantic (46° S, 60° W) (CASTELLANOS AND LANDONI, 1988); South Shetland Islands (DELL, 1990; ZELAYA AND GEIGER, 2007) and Western Antarctic Peninsula (POWELL, 1951; DELL, 1990; ZELAYA AND GEIGER, 2007; this study), Bellingshausen Sea (70-71° S, 83-88° W) (PELSENEER, 1903) to off Thurston Island (new record), Ross Sea (DELL, 1990; ZELAYA AND GEIGER, 2007), Terre Adélie (POWELL, 1958; ARNAUD, 1972) and Wilkes Land (DELL, 1990), Davis Sea (THIELE, 1912; EGOROVA, 1982; DELL, 1990; ZELAYA AND GEIGER, 2007), Kerguelen and Crozet Islands (CANTERA AND ARNAUD, 1985; ZELAYA AND GEIGER, 2007), Enderby Land (POWELL, 1958; ZELAYA AND GEIGER, 2007), Marion and Prince Edward Islands (BRANCH *ET AL.*, 1991), *ca.* 40° E (GRIFFITHS, LINSE AND CRAME, 2003), in 24° E (NUMANAMI AND OKUTANI, 1990a; NUMANAMI, 1996) and in 3° E-11° E (ZELAYA AND GEIGER, 2007); from 18 m (DELL, 1990) to 4420 m (ZELAYA AND GEIGER ,2007).

Family Fissurellidae Fleming, 1822

Genus *Cornisepta* McLean and Geiger, 1998

Cornisepta antarctica (Egorova, 1972) (Fig. 6)

Fissurisepta antarctica Egorova, 1972: 383, figs. 1a-b; Egorova, 1982: 10, figs. 66-67; Hain, 1990: 34, pl. 10, fig. 6, pl. 28, fig. 8 (radula).
Cornisepta antarctica: McLean and Geiger, 1998: 20, figs. 10a-g.

Material studied: 2 spm. (2.8 x 2.0 - 3.4 x 3.1 mm), MB14.

Remarks: Although it has a *Fissurisepta* shell form, McLean and Geiger (1998), described the new genus *Cornisepta* from this species, mainly by its radular characteristics. There are no similar species in Antarctica.

Distribution: Only known from the Weddell (Hain 1990; McLean and Geiger 1998), Bellingshausen (new record) and Davis Seas (Egorova, 1972, 1982); from 280 m to 700 m (Egorova, 1972).

Genus *Puncturella* Lowe, 1827

Puncturella spirigera Thiele, 1912 (Fig. 7)

Puncturella spirigera Thiele, 1912: 186, pl. 11, figs. 4-10; Powell, 1958: 180; Egorova, 1982: 10, figs. 24 (radula), 68-70; Dell, 1990: 76, figs. 125, 127; Numanami *et al*., 1996: 211 (table), pl. 1, figs 1-2; Zelaya, 2005: 112, fig. 4.

Material studied: 5 spm. (3.9 x 2.8 - 6.2 x 4.1 mm), PA39.

Remarks: This species was frequently considered as a junior synonym of the Sub-Antarctic, widely distributed species *P. conica* (d'Orbigny, 1841) (see Arnaud, 1972; Hain, 1990; Reid and Osorio, 2000), although Dell (1990) commented that *P. spirigera* probably formed part of a complex with wide distribution. These specimens are considered ,therefore, as *P. spirigera* until a systematic revision of the genus in the Southern Ocean and neighboring areas is attempted. Individuals from the Weddell Sea at 16-820 m depth of Hain (1990, p. 34), that were assigned to *P. conica*, resemble these specimens.

Distribution: South Georgia Island (Dell, 1990; Zelaya, 2005), also cited for the Weddell Sea and the South Shetland Islands (Zelaya, 2005); Western Antarctic Peninsula (new record), Ross Sea (Dell, 1990), Terre Adélie (Powell, 1958), Davis Sea (Thiele, 1912; Egorova, 1982), from 71° E to Enderby (Powell, 1958) and Syowa (Numanami *et al*., 1996); from 60 m (Egorova, 1982) to 2804 m (Dell, 1990). The references of Griffiths *et al*. (2003) for several sites in the South Pacific from *ca*. 42° S and Marion, Prince Edward, Crozet and Kerguelen Islands, may be related to *P. conica*.

Family Trochidae Rafinesque, 1815
Genus *Antimargarita* Powell, 1951

Antimargarita smithiana (Hedley, 1916) (Fig. 8)

Submargarita smithiana Hedley, 1916: 38, pl. 5, fig. 58.
Antimargarita smithiana: Powell, 1951: 100; 1958: 183; Egorova, 1982: 19, fig. 95.

Material studied: 1 spm. (7.4 x 8.0 mm), MB35.

Remarks: It differs from *A. dulcis* (Smith, 1907) mainly by its more spiral cords, which are similar in solidity.

Distribution: Known from East Antarctica, *ca*. 160° E (Griffiths *et al*., 2003), Commonwealth (Powell, 1958), Shackleton Ice Shelf (Hedley ,1916) and Davis Sea (Egorova, 1982), in West Antarctica only in the Bellingshausen Sea (new record); from 30 m (Powell, 1958) to 1117 m (new record).

Genus *Calliotropis* Seguenza, 1903

Calliotropis antarctica Dell, 1990 (Fig. 9)

Calliotropis antarctica Dell, 1990: 86, figs. 136-137, 143.

Material studied: 1 spm. (7.8 x 9.8 mm), MB2; 2 spm. (8.0 x 11.0 - 10.5 x 13.6 mm), MB34; 1 spm. (8.1 x 10.2 mm), MB37.

Remarks: Among the species within this genus, described from around Antarctica , the most closely related species is *C. lateumbilicata* Dell, 1990, which possesses a wider umbilicus and a lower spire with smoother sculpture. *Calliotropis eltanini* Dell, 1990 has less convex whorls with a more conic and angulose shape and *C. pelseneeri* (*sensu lato*) differs by its occluded or semi-occluded umbilicus and higher spire.

Distribution: Only reported from the Western Antarctic Peninsula (64° S, 68° W) (DELL, 1990), Bellingshausen Sea to off Thurston Island (new records), and the Bouvet Island (LINSE, 2006); from 247 m (LINSE, 2006) to 2818 m (DELL, 1990).

Calliotropis pelseneeri Cernohorsky, 1977 (Fig. 10)

Calliotropis pelseneeri Cernohorsky, 1977: 106; Hain, 1990: 37, pl. 1, fig. 5, pl. 17, fig. 5 (radula).
Calliotropis pelseneeri pelseneeri Dell, 1990: 82, fig. 131.
Margarita lamellosa Pelseneer, 1903: 18, pl. 5, fig. 47.
Solariellopis? lamellosa: Thiele, 1912: 187, pl. 11, fig. 12.
Calliotropis lamellosa: Powell, 1958: 182; Egorova, 1982: 14, fig. 76.

Material studied: 1 sh. (broken), MB4; 4 spm. (5.1 x 5.3 - 10.5 x 12.0 mm), MB30; 3 spm. (7.0 x 8.3 - 9.9 x 11.0 mm), MB31; 1 spm. (4.2 x 4.5 mm), MB35.

Remarks: DELL (1990) reported *C. pelseneeri* Cernohorsky, 1977 as *C. pelseneeri pelseneeri* in order to describe the new subspecies *C. pelseneeri rossiana* Dell, 1990, that differs by its more angulose whorls "with the major spiral sculpture much more prominent" (DELL, 1990). Individuals collected in BENTART cruises, were reported as *C. pelseneeri* (*s.l*) because of their more angulose whorls with a major spiral cord, but these specimens possess several grades in rising and thickness without being possible to observe a clearcut difference between these. The last whorl has a second principal spiral cord and the occluded or semi-occluded umbilicus is the main character that separates it from *C. eltanini* Dell, 1990, with an open umbilicus.

Distribution: Weddell Sea (DELL, 1990; HAIN, 1990), Bellingshausen Sea (PELSENEER, 1903; this study), Davis Sea (THIELE, 1912; EGOROVA, 1982) and Enderby Land (POWELL, 1958); from 371 m (HAIN, 1990) to 1814 m (new record).

Genus *Margarella* Thiele, 1893

Margarella antarctica (Lamy, 1905) (Fig. 11)

Margarita antarctica Lamy, 1905: 481, fig. 5; 1906b: 9, pl. 1, figs. 2-4.
Valvatella antarctica: Melvill and Standen, 1907: 129; Lamy, 1911a: 13.
Margarella antarctica: Powell, 1951: 98, fig. G9 (radula); Linse, 2002: 69, pl. 2, fig. 9.1.1- 13, 14-16 (radula); Zelaya, 2004: 113 (table), fig. 8 (radula).

Margarites antarctica: Dell, 1990: 79 (text), fig. 178.

Material studied: 8 spm. (3.7 x 4.8 - 8.0 x 10.8 mm), MAR.

Remarks: The low spire and open umbilicus separate it from the other two species of this genus reported from West Antarctica: the deeper water species *Margarella refulgens* (Smith, 1907), and *M. whiteana* Linse, 2002, which also differs by having spiral ribs. However, there are others species confined to South Georgia Island (see ZELAYA, 2005), such as *M. achilles* (Strebel, 1908), *M. jason* Powell, 1951, *M. obsoleta* Powell, 1951, *M. steineni* (Strebel, 1905), *M. subantarctica* (Strebel, 1908) and *M. tropidophoroides* (Strebel, 1908).

Distribution: West Antarctica,only from the South Orkney (MELVILL AND STANDEN, 1907; POWELL, 1951; LINSE, 2002) and South Shetland Islands (POWELL, 1951), Western Antarctic Peninsula (LAMY, 1906b, 1911a; THIELE, 1912; POWELL, 1951; LINSE, 2002; this study) and the Bellingshausen Sea (70° S, 81° W) (LAMY, 1911a); from 0 m (POWELL, 1951) to 460 m (LAMY, 1911a).

Margarella refulgens (Smith, 1907) (Fig. 12)

Valvatella refulgens Smith, 1907a: 11, pl. 2, fig. 7; Hedley, 1911: 4.

Margarella refulgens: Thiele, 1912: 188; Smith, 1915: 64; Hedley, 1916: 37; Eales, 1923: 9; Powell, 1958: 182; Egorova, 1982: 16, figs. 28 (radula), 82; Hain, 1990: 38, pl. 1, fig. 7, pl. 17, figs. 7-8 (radula).

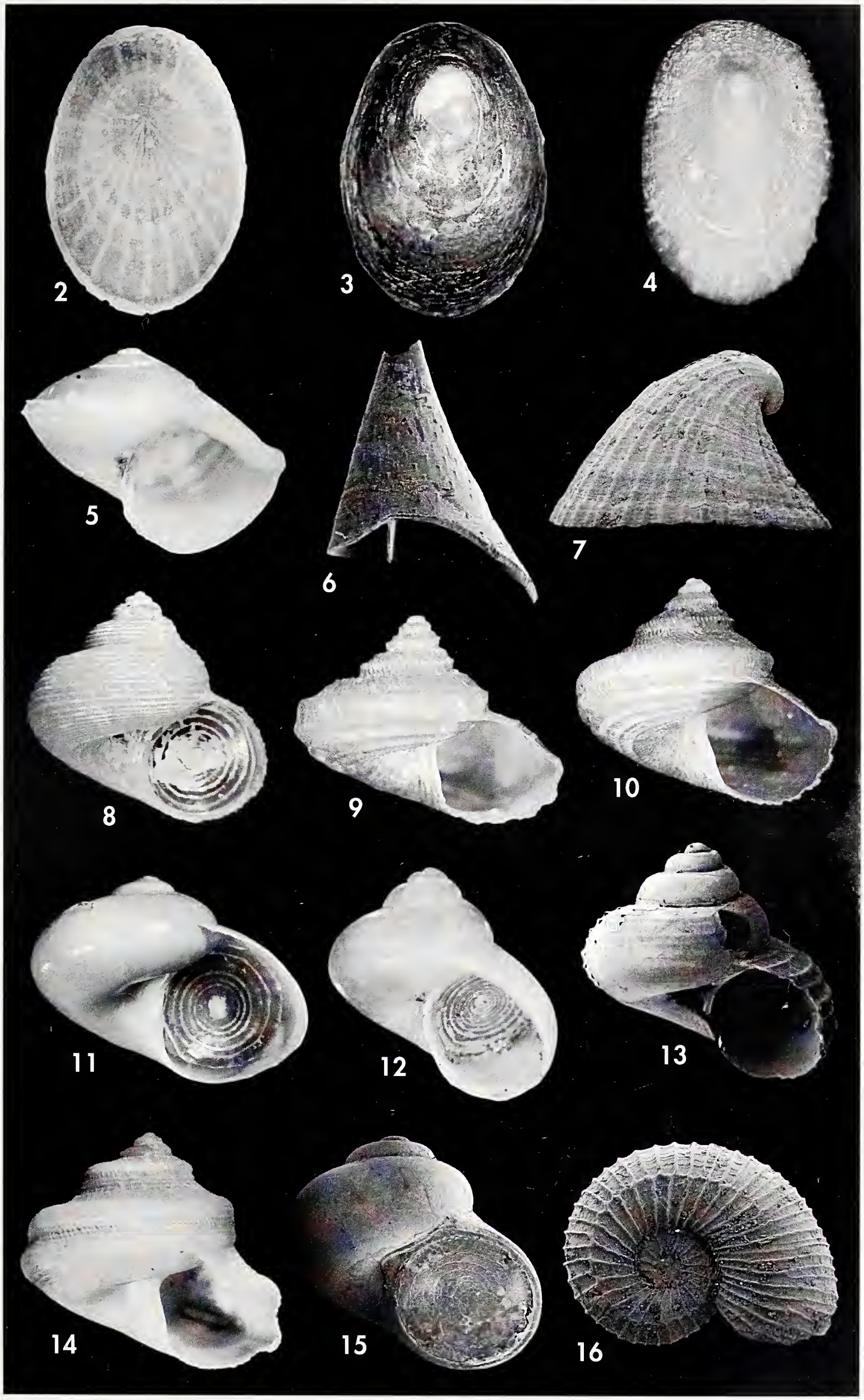
Margarites refulgens: Arnaud, 1972: 115, figs. 2 (anatomy), 5 (radula); Dell, 1990: 78, figs. 175-177; Numanami, 1996: 25, figs. 12A-E, F (radula).

Material studied: 3 spm. (3.7 x 4.1 - 4.6 x 6.0 mm), PI8; 6 spm. (2.2 x 2.6 - 5.7 x 6.2 mm), PA20; 2 spm. (3.5 x 4.3 - 5.6 x 6.1 mm), PA22; 1 spm. (4.0 x 4.7 mm), PA39; 1 spm. (4.3 x 5.0 mm), LOW.

Remarks: It differs from *Margarella antarctica* by its narrow or semi-occluded umbilicus and higher spire. Although this species has been cited as *Margarites* or *Margarella*, ZELAYA (2004) indicates that the constancy of five lateral teeth of the radula and the morphology of the first marginal tooth with a base that is greatly enlarged laterally, but with a well-developed shaft and cutting edge, place the species in genus *Margarella*. Those characteristics were observed on radulae detailed by ARNAUD (1972), EGOROVA (1982) and HAIN (1990). Conversely, in *Margarites* the number of lateral teeth varies and the first marginal tooth is represented by an expanded plate, without cutting edge. NUMANAMI (1996) described *Margarites gunnerusensis* and *Margarites biconicus* from East Antarctica, with characteristics that clearly separate them from *M. refulgens*, such as periostracum and angulose whorls, respectively.

(Right page) Figure 2. *Nacella polaris concinna*, 29.6 x 20.5 mm, PA20. Figure 3. *Nacella polaris polaris*, 29.8 x 20.5 mm, MAR. Figure 4. *Iothia coppingeri*, 5.7 x 4.1 mm, PA22. Figure 5. *Anatoma euglypta*, 4.8 x 6.1 mm, MB38. Figure 6. *Cornisepta antarctica*, 2.8 x 2.0, MB14. Figure 7. *Puncturella spirigera*, 5.6 x 3.6 mm, PA39. Figure 8. *Antimargarita smithiana*, 7.4 x 8.0 mm, MB35. Figure 9. *Calliotropis antarctica*, 7.8 x 9.8 mm, MB2. Figure 10. *Calliotropis pelseneeri*, 10.5 x 12.0 mm, MB30. Figure 11. *Margarella antarctica*, 9.1 x 6.8 mm, MAR. Figure 12. *Margarella refulgens*, 3.7 x 4.1 mm, PI8. Figure 13. *Solariella antarctica*, 3.9 x 4.1 mm, MB11. Figure 14. *Tropidomarga biangulata*, 6.9 x 8.0 mm, LOW. Figure 15. *Cirsonella extrema*, 2.5 x 2.7 mm, PA39. Figure 16. *Liotella endeavourensis*, 0.9 x 1.7 mm, MB38.

(Página derecha) Figuras 2-16. Ver los nombres científicos en el rótulo en inglés.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Distribution: Presumably Circum-antarctic. South Sandwich Islands (Dell 1990), Weddell Sea (Hain, 1990), Magellan (Thiele, 1912), South Shetland Islands, Western Antarctic Peninsula and Peter I Island (new records), Ross Sea (Smith, 1907a; Hedley, 1911; Smith, 1915; Dell, 1990), *ca.* 163° E (Smith, 1915), Commonwealth (Hedley, 1916), Terre Adélie (Powell, 1958; Arnaud, 1972), Wilkes Land (Dell, 1990), Davis Sea (Thiele, 1912; Hedley, 1916; Powell, 1958; Egorova, 1982; Dell, 1990), Kerguelen Islands (Thiele,1912), Enderby Land (Powell, 1958), *ca.* 40°E, Prince Edward Island (Griffiths *et al.*, 2003) and 24°E (Numanami, 1996); from 0 m (Arnaud, 1972) to 1108 m (Hain, 1990). Dell (1990) doubts the distribution boundaries, due to records of some specimens reported as *M. antarctica* from some localities close to the South Sandwich Islands; but they could correspond to *M. refulgens*.

Genus *Solariella* Wood, 1842

Solariella antarctica Powell, 1958 (Fig. 13)

Solariella antarctica Powell, 1958: 183, pl. 2, fig. 4; Dell, 1990: 98, fig. 147.

Material studied: 1 spm. (3.9 x 4.1 mm), MB11.

Remarks: The individual reported by Hain (1990 p. 40) as *Solariella* sp. resembles BENTART specimen. Other described species are *Solariella kempi* Powell, 1951, *S. charopus charopus* (Watson, 1879), *S. charopus caeruleus* (Watson, 1879) and *S. bathyantarctica* Numanami, 1996, all of them with more or finer and denser spiral cords.

Distribution: Weddell Sea (Griffiths *et al.*, 2003), Bellingshausen Sea (new record), Ross Sea (Dell, 1990) and Kemp Land (Powell, 1958); from 455 m (Dell, 1990) to 1289 m (new record).

Genus *Tropidomarga* Powell, 1951

Tropidomarga biangulata Powell, 1951 (Fig. 14)

Tropidomarga biangulata Powell, 1951: 101, pl. 5, figs. 5, G6 (radula); Castellanos and Landoni, 1989: 26, pl. 2, fig. 6; Zelaya, 2005: 115.

Material studied: 1 spm. (6.9 x 8.0 mm), LOW.

Distribution: Only in the South Georgia (Powell, 1951) and the South Shetland Islands (Powell, 1951; this study); from 97 m (new record) to 342 m (Powell, 1951).

Family Skeneidae Clark, 1851
Genus *Cirsonella* Angas, 1877

Cirsonella extrema Thiele, 1912 (Fig. 15)

Cirsonella extrema Thiele, 1912: 191, pl. 11, fig. 23; Powell, 1951: 103; 1958: 184; Egorova, 1982: 21, fig. 99; Dell, 1990: 99, fig. 160; Numanami, 1996: 43, figs. 22A-D, F (radula).

Material studied: 4 spm. (2.0 x 2.2 - 2.4 x 3.0 mm), PA39.

Remarks: Together with this species, only *Cirsonella kerguelenensis* Thiele, 1912 was cited from the Southern Ocean and neighboring areas, but *C. extrema* differs by having a lower spire.

Distribution: Weddell Sea (Griffiths et al., 2003), South Shetland Islands (Dell, 1990), Western Antarctic Peninsula (new record), Ross Sea (Powell, 1951; Dell, 1990), Wilkes Land (Dell, 1990), Davis Sea (Thiele, 1912; Egorova, 1982; Dell, 1990), Enderby Land (Powell, 1958) and 24° E (Numanami, 1996); from 15 to 870 m (Dell, 1990).

Genus *Liotella* Iredale, 1915

Liotella endeavourensis Dell, 1990 (Fig. 16)

Liotella endeavourensis Dell, 1990: 103, figs. 172-173.

Material studied: 1 spm. (0.9 x 1.7 mm), MB38.

Remarks: The only Antarctic representative known. According to Dell (1990) it presents a certain likeness to species from southern New Zealand, and differs from them in the sunken spire and by having a pair of raised spiral cords in the last whorl.

Distribution: Only known from the Ross Sea at 362 m (Dell, 1990) and Bellingshausen Sea at 1324 m (new record).

Family Turbinidae Rafinesque, 1815
Genus *Leptocollonia* Powell, 1951

Leptocollonia innocens (Thiele, 1912) (Fig. 17)

Leptothyra innocens Thiele, 1912: 192, pl. 11, figs. 24, 24a.
Leptocollonia innocens: Powell, 1951: 105; 1958; 183; Egorova, 1982: 20, figs. 32 (radula), 90; Dell, 1990: 98, figs. 161-162; Hain, 1990: 41, pl. 2, fig. 1, pl. 18, figs. 7-8 (radula); Numanami, 1996: 57, figs. 31A-D, E (operculum), F (radula).

Material studied: 6 spm. (2.8 x 3.9 - 6.0 x 6.3 mm), MB37.

Remarks: *L. thielei* Powell, 1951, from South Georgia Island, is the only other species known from the area, but *L. innocens* differs mainly by having fewer spiral cords on the spire and last whorl.

Distribution: Weddell (Dell, 1990; Hain, 1990), Bellingshausen (new record), Ross (Dell, 1990) and Davis Seas (Thiele 1912; Powell, 1958; Egorova, 1982), Enderby Land (Powell, 1958), 34° E and 24° E (Numanami, 1996); from 193 m (Powell, 1958) to 673 m (Hain, 1990).

Superorder Caenogastropoda Cox, 1960
Family Zerotulidae Warén and Hain, 1996
Genus *Dickdellia* Warén and Hain, 1996

Dickdellia labioflecta (Dell, 1990) (Fig. 18)

Laevilitorina labioflecta Dell, 1990: 110, figs. 187-188.
Dickdellia labioflecta: Warén and Hain, 1996: 321, figs. 27-29, 30a-b, 31-32, 34e.
Mesogastropoda sp. 2: Hain, 1990: 54, pl. 5, figs. 1a-d, pl. 22, fig. 6 (radula).

Material studied: 10 spm. (2.8 x 3.1 - 2.9 x 3.4 mm), PA22; 3 spm. (3.1 x 3.6 - 3.2 x 3.7 mm), MAR.

Remarks: It differs from littorinid species by having a less calcified shell and more globose aperture. Juveniles live as ectoparasites on the cuticle of the pycnogonid *Colossendeis megalonyx megalonyx* (Lehmann, Gailer, Melzer and Schwabe, 2007).

Distribution: Weddell Sea (Hain, 1990; Warén and Hain, 1996), South Shetland Islands (Dell, 1990), Western Antarctic Peninsula (new record) and Ross Sea (Dell, 1990); from 220 to 891 m (Dell, 1990).

Family Eatoniellidae Ponder, 1965
Genus *Eatoniella* Dall, 1876

Eatoniella glacialis (Smith, 1907) (Fig. 19)

Rissoia glacialis Smith, 1907a: 9, pl. 2, fig. 4; Smith, 1915: 65.
Rissoa glacialis: Hedley, 1911: 5.
Subonoba glacialis: Hedley, 1916: 48.
Eatoniella glacialis: Arnaud, 1972: 118, figs. 8 (radula), 11 (operculum); Ponder, 1983: 11, figs. 2c, 5e; Dell, 1990: 111, fig. 191; Numanami, 1996: 62, figs. 34A-B, C (operculum), D (radula); Zelaya, 2005: 115, fig. 14.
Eatoniella kerguelensis f. *major* Strebel, 1908: 57, pl. 4, figs. 56a-c.

Material studied: 1 spm. (2.8 x 1.9 mm), PA21; 2 spm. (2.0 x 1.1 - 2.8 x 1.6 mm), PA39.

Remarks: Its resemblance to *E. kerguelenensis* (*s.l.*) was discussed by Ponder (1983), who found that the species *Eatoniella kerguelensis* f. *major* Strebel, 1908, from the Western Antarctic Peninsula is a junior synonym of *E. glacialis*.

Distribution: Circumantarctic. Weddell Sea (Dell, 1990), South Georgia Island (Zelaya, 2005), South Shetland Islands (Strebel, 1908; Dell, 1990) and Western Antarctic Peninsula (Strebel, 1908; Dell, 1990; this study), Ross Sea (Smith, 1907a; Hedley 1911; Smith, 1915; Dell, 1990), Cape Adare (Smith, 1915), Balleny Islands (Griffiths *et al.*, 2003), Commonwealth (Hedley, 1916), Terre Adélie (Arnaud, 1972) and Enderby Land (Dell, 1990), 24° E (Numanami, 1996) and *ca.* 40° E (Griffiths *et al.*, 2003); from 6 m (Arnaud, 1972) to 870 m (Dell, 1990).

Eatoniella kerguelenensis regularis (Smith, 1915) (Fig. 20)

Rissoia regularis Smith, 1915: 65, pl. 1, fig. 5.
Eatoniella kerguelenensis regularis: Ponder, 1983: 7, figs. 2b, 3a-c; Dell, 1990: 113, fig. 190; Branch *et al.*, 1991: 57 (key); Numanami, 1996: 65, figs. 36A-B, C (operculum), D (radula).
Eatoniella regularis: Castellanos, 1989: 26, pl. 2, fig. 26.
Eatoniella kerguelenensis (Smith): Lamy, 1906b: 7; Melvill and Standen, 1907: 134; Lamy, 1911a: 11; Hedley, 1916: 46; Arnaud, 1972: 118, figs. 9 (radula), 11 (operculum) (no Smith, 1875).
Eatoniella kerguelensis f. *major* Strebel: Melvill and Standen, 1912: 351; Powell, 1951: 110 (no Strebel, 1908).

Material studied: 2 spm. (3.5 x 2.0 - 4.0 x 2.2 mm), PA20.

Remarks: It differs from the similar subspecies *E. kerguelenensis kerguelenensis* (Smith, 1875) by having a shell that is usually larger, thicker, with flatter whorls and a higher spire of $^1/_2$ or 1 whorl more. There are the same differences, though more evident, with other species,such as *E. glacialis* (Smith, 1907) and *E. demissa* (Smith, 1915).

Distribution: Weddell Sea and South Georgia Island (GRIFFITHS *ET AL*., 2003), South Orkney Islands (MELVILL AND STANDEN, 1907, 1912; POWELL, 1951), South Atlantic Ocean (CASTELLANOS, 1989) and Falkland/Malvinas Islands (CARCELLES, 1953), South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (LAMY ,1906b; DELL, 1990; this study), Ross Sea (SMITH, 1915; DELL, 1990) to Cape Adare (SMITH, 1915), Commonwealth (HEDLEY, 1916), Terre Adélie (ARNAUD, 1972), Wilkes Land and *ca*. 63° E (DELL, 1990), Marion and Prince Edward Islands (BRANCH *ET AL*., 1991), *ca*. 40° E (GRIFFITHS *ET AL*., 2003) and 24° E (NUMANAMI, 1996); from 0 m (DELL, 1990) to 457 m (SMITH, 1915).

Eatoniella cf. *kerguelenensis kerguelenensis* (Smith, 1875) (Fig. 21)

Eatonia kerguelenensis Smith, 1875: 70.
Eatoniella kerguelenensis kerguelenensis: Smith, 1879: 174, pl. 9, fig. 10; Powell, 1957: 129; 1958: 185; Arnaud, 1972: 118 (in part); Ponder, 1983: 11, figs. 2a, 7e-f; Troncoso *et al*. 2001: 92, figs. 10, 43 (radula).
Eatoniella kerguelensis (sic): Thiele, 1912: 235, pl. 14, fig. 26, pl. 16, fig. 1 (radula); Castellanos, 1989: 23, pl. 2, fig. 22, pl. 4, fig. 45.

Material studied: 14 spm. (1.4 x 1.0 - 3.0 x 1.8 mm), PA39; 1 spm. (1.6 x 1.1 mm), PA41.

Remarks: Although PONDER (1983) restricted *E. kerguelenensis kerguelenensis* to East Antarctica, CASTELLANOS (1989) presented a specimen from the Antarctic Peninsula, which was clearly different from *E. kerguelenensis regularis*. Likewise, our specimens differ by having a usually smaller shell, thinner, with more convex whorls and with a shorter spire of 1/2 or 1 whorl less.

Distribution: Mainly in East Antarctica. Known from Commonwealth (POWELL, 1958), Terre Adélie (ARNAUD, 1972) and Kerguelen Islands (SMITH, 1879; THIELE, 1912; POWELL, 1957; TRONCOSO *ET AL*., 2001). Also from the Western Antarctic Peninsula (this study). CASTELLANOS (1989) assigned a widespread Antarctic and Sub-Antarctic distribution in South Georgia, South Orkney Islands and Antarctic Peninsula, and GRIFFITHS *ET AL*. (2003) added the Weddell Sea. The bathymetric range is from 0 m (POWELL, 1957) to 100 m (POWELL, 1960).

Family RISSOIDAE Gray, 1847
Genus *Onoba* H. and A. Adams, 1852

Onoba gelida (Smith, 1907) (Fig. 22)

Rissoia gelida Smith, 1907a: 9, pl. 2, fig. 5; Smith, 1915: 65.
Rissoa gelida: Hedley, 1911: 5; Thiele, 1912: 195, pl. 11, figs. 37-38.
Subonoba gelida: Hedley, 1916: 48; Powell, 1958: 185; Arnaud, 1972: 121; Egorova, 1982: 24, figs. 37 (radula), 108-109.
Onoba gelida: Ponder, 1983: 20, figs. 13a-b, 16a-d; Dell, 1990: 114, fig. 194; Ponder and Worsfold, 1994: 54; Numanami, 1996: 66, figs. 38A-B; Zelaya, 2005: 116, fig. 16.
Subonoba contigua Powell, 1958: 184, pl. 1, fig. 8.

Material studied: 6 spm. (1.8 x 1.1 - 2.4 x 1.8 mm), PI5; 4 spm. (2.1 x 1.4 - 2.7 x 1.7 mm), PI8; 1 spm. (2.6 x 1.4 mm), MB14; 1 spm. (2.2 x 1.6 mm), PA21; 1 spm. (2.0 x 1.1 mm), MB34; 9 spm. (1.1 x 0.8 - 3.0 x 1.9 mm), PA39; 3 spm. (1.3 x 1.0 - 1.7 x 1.1 mm), PA41; 3 spm. (1.2 x 1.0 - 1.4 x 1.1 mm), PA42; 1 spm. (2.1 x 1.5 mm), LOW.

Remarks: Several Antarctic and Sub-Antarctic species, sharing wide shape and spiral sculpture have been cited. In this respect, *O. scythei* (Philippi, 1868) from Tierra del Fuego Island has a great affinity in macrosculpture, though more elongate. *O. filostria* (Melvill and Standen, 1912), *O. suavis* (Thiele, 1925), *O. transenna* (Watson, 1886), *O. subantarctica subantarctica* (Thiele, 1912) and *O. subantarctica wilkesiana* (Hedley, 1916), differ by having more spirals; on the other hand, *O. delecta* Ponder, 1983 and *O. paucicarinata* Ponder, 1983, have less spirals. *O. inflatella* (Thiele, 1912) differs in having a widely open umbilicus and more spaced spirals and *O. grisea* (Martens, 1885) by flatter cords. PONDER (1983) synonymized the species *Subonoba contigua* Powell, 1958.

Distribution: South Georgia Island (PONDER AND WORSFOLD, 1994; ZELAYA, 2005) and cited for the Weddell Sea (ZELAYA, 2005); South Shetland Islands (PONDER, 1983; DELL, 1990; this study), Western Antarctic Peninsula, Bellingshausen Sea and Peter I Island (new records), Ross Sea (SMITH, 1907a; HEDLEY, 1911; SMITH, 1915; DELL, 1990) to Cape Adare (SMITH, 1915), Commonwealth (HEDLEY, 1916; POWELL, 1958), Terre Adélie (ARNAUD, 1972), Wilkes Land (DELL, 1990), Davis Sea (THIELE, 1912; EGOROVA, 1982; DELL, 1990), Enderby Land (POWELL, 1958), *ca.* 40° E (GRIFFITHS *ET AL.*, 2003), 24° E (NUMANAMI, 1996) and Bouvet Island (LINSE, 2006); from 4 m (DELL, 1990) to 1272 m (new record).

Onoba kergueleni (Smith, 1875) (Fig. 23)

Rissoa kergueleni Smith, 1875: 69; 1879: 176, pl. 9, fig. 12; Thiele, 1912: 238, pl. 14, fig. 30.
Onoba kergueleni: Ponder, 1983: 17, figs. 12f-h, 18 e-g; Dell, 1990: 115, fig. 196.
Rissoa adarensis Smith, 1902: 205, pl. 24, fig. 17; Melvill and Standen, 1907: 132; Hedley, 1911: 5; Lamy, 1911a: 10.
Rissoia adarensis: Smith, 1907a: 8, pl. 2, fig. 2; Smith, 1915: 65.
Ovirissoa adarensis: Hedley, 1916: 47; Arnaud, 1972: 120.
? *Rissoa columna* Pelseneer, 1903: 21, pl. 5, fig. 55.
Rissoa observationis Thiele, 1912: 239, pl. 15, fig. 4.

Material studied: 1 spm. (3.0 x 1.4 mm), PI8.

Remarks: The extremely thin and transparent periostracum marks the difference with all species with smooth surface known for the area, such as *O. anderssoni* (Strebel, 1908), *O. georgiana* (Pfeffer, 1886) and *O. melvilli* (Hedley, 1916), these last two also with weak spirals. *Rissoa adarensis* Smith, 1902, *R. columna* Pelseneer, 1903 and *R. observationis* Thiele, 1912 were synonymized by PONDER (1983); the last two species were described from immature specimens.

Distribution: Circumantarctic. South Orkney (MELVILL AND STANDEN, 1907) and Signy Islands (PONDER, 1983), South Shetland Islands (PONDER, 1983; DELL, 1990), Western Antarctic Peninsula (LAMY, 1911a) and Bellingshausen Sea (70° S, 83° W) (PELSENEER, 1903), Peter I Island (new record), Ross Sea (SMITH, 1907a; HEDLEY, 1911; SMITH, 1915; DELL, 1990), Cape Adare (SMITH, 1902), Commonwealth (HEDLEY, 1916), Terre Adélie (ARNAUD, 1972) and Wilkes Land (DELL, 1990), Kerguelen Islands (SMITH, 1879), Crozet Island and Mac Robertson Land (DELL, 1990); from 0 m (ARNAUD, 1972) to 870 m (DELL, 1990).

Onoba turqueti (Lamy, 1905) (Fig. 24)

Rissoia turqueti Lamy, 1905: 479, fig. 3; 1906b: 6, pl. 1, fig. 8.
Rissoa turqueti: Melvill and Standen, 1912: 350.
Subonoba turqueti: Powell, 1951: 55; Arnaud, 1972: 121.

Onoba turqueti: Ponder, 1983: 16, figs. 11f-g, 12a-e, 14c-e; Dell, 1990: 114, fig. 195; Ponder and Worsfold, 1994: 54.
Rissoia fraudulenta Smith, 1907a: 9, pl. 2, fig. 3.
Rissoa fraudulenta: Melvill and Standen, 1907: 133; Thiele, 1912: 194, pl. 11, fig. 35.
Subonoba fraudulenta: Powell, 1951: 110; Egorova, 1982: 23, figs. 36 (radula), 111.
Subonoba bickertoni Hedley, 1916: 47, pl. 7, fig. 76.

Material studied: 2 spm. (1.8 x 1.0 - 2.1 x 1.1 mm), PI5.

Remarks: The spiral sculpture is one of the main characters that differentiate Antarctic and Sub-Antarctic species with a common elongate shape. In this sense, *O. sulcula* Ponder and Worsfold, 1994 differs in having threads interrupted by dot-like marks, *O. schraderi* (Strebel, 1908) by its triple threads, *O. sactipauli* (Vélain, 1877) and *O. egorovae* Numanami, 1996 by their weaker threads, *O. steineni* (Strebel, 1908) and *O. protofimbriata* Ponder and Worsfold, 1994 by their thicker ridges and *O. lantzi* (Vélain, 1877), although having a similar sculpture, differs in having shouldered whorls. *Rissoia fraudulenta* Smith, 1907 and *Subonoba bickertoni* Hedley, 1916 were synonymized by Ponder (1983).

Distribution: Cited *ca.* 10° W (Griffiths et al., 2003); Burdwood Bank (Melvill and Standen, 1912), South Georgia (Ponder and Worsfold, 1994), South Orkney (Melvill and Standen, 1907; Powell, 1951), Signy (Ponder 1983) and South Shetland Islands (Ponder, 1983; Dell, 1990), Western Antarctic Peninsula (Lamy, 1905, 1906b; Dell, 1990), Peter I Island (new record), Ross Sea (Smith, 1907a; Dell, 1990), Macquarie Island (Powell, 1951), Commonwealth (Hedley, 1916), Terre Adélie (Arnaud, 1972) and Davis Sea (Thiele, 1912, Egorova, 1982); from 2 to 385 m (Egorova, 1982).

Genus *Powellisetia* Ponder, 1965

Powellisetia deserta (Smith, 1907) (Fig. 25)

Rissoia deserta Smith, 1907a: 9, pl. 2, fig. 1.
Rissoa deserta: Thiele, 1912: 194, pl. 11, fig. 33; Melvill and Standen, 1912: 349.
Subonoba deserta: Hedley, 1916: 48; Powell, 1951: 62; Powell, 1958: 185; Arnaud, 1972: 120; Egorova, 1982: 23, figs. 35 (radula), 110.
Powellisetia deserta: Ponder, 1983: 24, figs. 19a-c, 21c; Dell, 1990: 116, fig. 197; Numanami, 1996: 71, figs. 43A-C, D (radula).

Material studied: 2 spm. (2.2 x 1.2 - 2.8 x 1.8 mm), PA41.

Remarks: The size and shape are the main characters that allow the differentiation of several species without any spiral sculpture. *P. principis* (Watson, 1886) is a tiny species that does not reach more than 2.1 mm, *P. australis* (Watson, 1886) and *P. inornata* (Strebel, 1908) differ in having a more elongated shape. *P. pelseneeri* (Thiele, 1912), that was described as a new name for *Rissoa subtruncata* Pelseneer, 1903, from the Bellingshausen Sea, differs by having finer spiral striae.

Distribution: Cited *ca.* 10° W (Griffiths et al., 2003); South Orkney (Melvill and Standen, 1912) and Signy Islands (Ponder, 1983), Western Antarctic Peninsula (new record), Ross Sea (Smith, 1907a; Ponder, 1983; Dell, 1990), Commonwealth (Hedley, 1916; Powell, 1958), Terre Adélie (Arnaud, 1972); Wilkes Land (Dell, 1990), Davis Sea (Thiele, 1912; Egorova, 1982), *ca.* 60°E (Griffiths et al., 2003), Enderby Land (Powell, 1958), *ca.* 50° E and 40° E (Griffiths et al., 2003) and 24° E (Numanami, 1996); from 4 m (Ponder, 1983) to 870 m (Dell, 1990).

Family CAPULIDAE Fleming, 1822
Genus *Torellia* Lovén in Jeffreys, 1867

Torellia insignis (Smith, 1915) (Fig. 26)

Neoconcha insignis Smith, 1915: 68, pl. 1, fig. 9; Eales, 1923: 13, fig. 11; Arnaud, 1972: 123; Numanami and Okutani, 1990b: 87, figs. 2C-D, 3A (radula), 5A; Numanami, 1996: 89, figs. 58A-B, D, C (radula).

Torellia insignis: Warén, Arnaud and Cantera, 1986: 163 (text), fig. 6; Dell, 1990: 135, fig. 229-230; Hain, 1990: 48, pl. 3, fig. 1, pl. 20, fig. 6 (radula).

Material studied: 1 spm. (16.9 x 21.0 mm), LOW.

Remarks: The higher spire, and very thick periostracum, rather lamellose along the growth lines and raised into long, divergent hairy processes on the shoulder and on the spiral carinae, separates *T. insignis* from the other Antarctic and Sub-Antarctic species: *T. mirabilis* (Smith, 1907), *T. planispira* (Smith, 1915), *T. exilis* (Powell, 1958), *T. smithi* Warén, Cantera and Arnaud, 1986, *T. angulifera* Warén, Cantera and Arnaud, 1986 and *T. cornea* Powell, 1951. NUMANAMI AND OKUTANI (1990b) have studied and compared this species with the most similar species *T. lanata* Warén, Arnaud and Cantera, 1986, from the Kerguelen Islands, that differs in having a more angulose aperture. *T. antarctica* (Thiele, 1912) differs in having a more dense sculpture and less developed periostracum.

Distribution: Weddell Sea (HAIN, 1990), South Shetland Islands (new record), Ross Sea (SMITH, 1915; DELL, 1990), Terre Adélie (ARNAUD, 1972), *ca.* 40°E (GRIFFITHS *ET AL.*, 2003) and 24° E (NUMANAMI AND OKUTANI, 1990b; NUMANAMI, 1996); from 91 m (DELL, 1990) to 695 m (HAIN, 1990).

Torellia mirabilis (Smith, 1907) (Fig. 27)

Trichoconcha mirabilis Smith, 1907a: 6, pl. 1, figs. 7-7b; Hedley, 1916: 50; Eales, 1923: 14; Powell, 1951: 124; Castellanos and Landoni, 1990: 7, pl. 3, fig. 35; Hain, 1990: 46, pl. 2, figs. 12a-e, pl. 20, figs. 1-2 (radula).

Torellia mirabilis: Thiele, 1912: 197; Smith, 1915: 68; Warén *et al.*, 1986: 163 (text); Dell, 1990: 131, figs. 222-225; Numanami and Okutani, 1990b: figs. 2E-F; Numanami, 1996: 92 (table), figs. 60A-B, C (radula); Numanami *et al.*, 1996: 211 (table), pl. 1, figs. 10-11; Zelaya, 2005: 119, fig. 25.

Material studied: 1 spm. (22.0 x 30.0 mm), PA39.

Remarks: Together with *T. planispira* (Smith, 1915) and *T. cornea* Powell, 1951, there are the three species with low spire, but *T. planispira* has strong spiral carinae instead of the rounded shape of *T. mirabilis*, and *T. cornea* has a broader and depressed aperture, not rounded as in *T. mirabilis*.

Distribution: Weddell Sea (HAIN, 1990), South Georgia (POWELL, 1951; DELL, 1990; ZELAYA, 2005) and South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (new record), Ross Sea (SMITH, 1907a; SMITH, 1915; DELL, 1990), Commonwealth to Terre Adélie (HEDLEY, 1916), Davis Sea (THIELE, 1912; HEDLEY, 1916); also is indicated from Kerguelen and Crozet Islands (ZELAYA, 2005); Enderby Land (NUMANAMI *ET AL.*, 1996); from 70 to 1120 m (DELL, 1990).

Torellia planispira (Smith, 1915) (Fig. 28)

Trichotropis planispira Smith, 1915: 67, pl. 1, fig. 7.

Trichoconcha planispira: Powell, 1958: 188; Hain, 1990: 47, pl. 2, fig. 13, pl. 20, fig. 3 (radula).
Torellia planispira: Warén *et al.*, 1986: 163 (text); Dell, 1990: 134; Numanami and Okutani, 1990b: 82, figs. 2A-B, 3B (radula), 5B; Numanami, 1996: 86, figs. 56A-B, D, C (radula).

Material studied: 3 spm. (2.6 x 3.9 - 3.7 x 5.3 mm), PA21; 1 spm. (4.0 x 5.8 mm), PA24.

Remarks: NUMANAMI AND OKUTANI (1990b) observed that its semi-detached whorls of the teleoconch allow differentiation from other related species.

Distribution: Weddell Sea (HAIN, 1990), cited for the South Shetland Islands (GRIFFITHS *ET AL.*, 2003); Western Antarctic Peninsula (new record), Ross Sea (SMITH, 1915; DELL, 1990), Mac Robertson Land (POWELL, 1958), *ca.* 40° E (GRIFFITHS *ET AL.*, 2003) and 24° E (NUMANAMI AND OKUTANI, 1990b, NUMANAMI, 1996); from 107 to 1056 m (new records).

Family VELUTINIDAE Gray, 1840
Genus *Marseniopsis* Bergh, 1886

Marseniopsis conica (Smith, 1902)

Lamellaria conica Smith, 1902: 206, pl. 24, fig. 4; Strebel, 1908: 60.
Marseniopsis conica: Smith, 1915: 66, Eales, 1923: 23; Egorova, 1982: 27, figs. 132-135; Dell, 1990: 164; Hain, 1990: 52, pl. 4, figs. 2a-c, pl. 21, figs. 7-8 (radula); Numanami and Okutani, 1991: 53, figs. 4A-E, 9A (radula); Numanami, 1996: 93, figs. 61A-E, 66A (radula).
Lamellariosis turqueti Vayssière, 1906: 40, pl. 4, figs. 42-53.

Material studied: 1 spm. (14.7 x 8.9 mm), PA21.

Remarks: It can be differentiated from the other two representatives of the genus in the area by its heterogeneous and rough mantle with numerous mammillate processes, giving a polygonal contour; it does not have an elliptic shape like *M. mollis* (Smith, 1902) and *M. syowaensis* Numanami and Okutani, 1991. According to NUMANAMI AND OKUTANI (1991) *Lamellariosis turqueti* Vayssière, 1906 is a junior synonym.

Distribution: Weddell Sea (HAIN, 1990) and Eastern Antarctic Peninsula (STREBEL, 1908), Western Antarctic Peninsula (new record), Ross Sea (SMITH, 1915; DELL, 1990), Cape Adare (SMITH, 1902), probably in the Macquarie Island (Tomlin 1948 in POWELL, 1960), Davis Sea (EGOROVA, 1982), Mac Robertson Land and 24° E (NUMANAMI AND OKUTANI, 1991); from 41 m (EGOROVA, 1982) to 860 m (DELL, 1990).

Marseniopsis mollis (Smith, 1902)

Lamellaria mollis Smith, 1902: 205, pl. 24, figs. 19-21; Hedley, 1911: 7.
Marseniopsis mollis: Thiele, 1912: 200; Smith, 1915: 66; Hedley, 1916: 53; Eales, 1923: 25; Arnaud, 1972: 126, fig. 17 (radula); Egorova, 1982: 28, figs. 40 (radula), 128-131; Dell, 1990: 164; Hain, 1990: 53, pl. 4, figs. 3a-c, pl. 22, figs. 1-2; Numanami and Okutani, 1991: 56, figs. 6A-D, 9B (radula), pl. 1, figs. 3-5; Numanami, 1996: 96, figs. 63A-D, 66B (radula); Numanami *et al.*, 1996: 212 (table, text), pl. 2, figs. 9-11.

Material studied: 4 spm. (44.5 x 33.0 - 47.7 x 38.9 mm), PI5; 5 spm. (41.2 x 33.4 - 59.9 x 48.4 mm), PI8.

Remarks: This species differs from *M. syowaensis* Numanami and Okutani, 1991, in having a more regular elliptic shape and homogeneous mantle.

Distribution: Weddell Sea (HAIN, 1990), South Shetland Islands (GRIFFITHS ET AL., 2003) and Western Antarctic Peninsula (DELL, 1990), Peter I Island (new record), Ross Sea (HEDLEY, 1911; SMITH, 1915; DELL, 1990), Cape Adare (SMITH, 1902), 163° E (SMITH, 1915), Commonwealth (HEDLEY, 1916), Terre Adélie (ARNAUD, 1972), Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (EGOROVA, 1982), Syowa (NUMANAMI AND OKUTANI, 1991; NUMANAMI 1996; NUMANAMI ET AL., 1996) and 24° E (NUMANAMI AND OKUTANI, 1991; NUMANAMI, 1996); from 1 m (HAIN, 1990) to 800 m (POWELL, 1960).

Marseniopsis syowaensis Numanami and Okutani, 1991

Marseniopsis syowaensis Numanami and Okutani, 1991: 58, figs. 7A-F, 9C (radula), pl. 1, figs. 1-2; Numanami, 1996: 99, figs. 65A-F, 66C (radula).

Material studied: 3 spm. (50.1 x 45.1 - 50.1 x 45.1 mm), PI5.

Remarks: The same differences as the similar species *M. mollis* (Smith, 1902) are indicated above and were established by NUMANAMI AND OKUTANI (1991).

Distribution: Only known from Syowa (NUMANAMI AND OKUTANI, 1991; NUMANAMI, 1996) and Peter I Island (new record); from 5 m (NUMANAMI, 1996) to 126 m (new record).

Family NATICIDAE Forbes, 1838

Genus *Falsilunatia* Powell, 1951

Falsilunatia delicatula (Smith, 1902) (Fig. 29)

Natica delicatula Smith, 1902: 206, pl. 24, fig. 6; 1907a: 5; Thiele, 1912: 199, pl. 12, figs. 16-17.
Falsilunatia delicatula: Dell, 1990: 148, figs. 237, 256-257, 269 (radula); Troncoso *et al.* 2001: 95, figs. 15, 46 (radula).

Material studied: 1 spm. (5.5 x 6.0 mm), MB4; 1 spm. (10.0 x 11.0 mm), PI5; 4 spm. (4.0 x 4.2 - 5.2 x 5.5 mm), PI8.

Remarks: The diameter (D) of the shell is greater than its height (H), the holotype having a D/H ratio of 1.03. On the other hand, similar species such as *F. soluta* (Gould, 1848), *F. fartilis* (Watson, 1881), *F. notocardensis* Dell, 1990, *F. eltanini* Dell, 1990 and *F. xantha* (Watson, 1881), differ in other features, such as thicker and/or higher shells. This species was considered a junior synonym of *Amauropsis grisea* (Martens, 1878) by CERNOHORSKY (1977), but DELL (1990) concluded that *F. delicatula* is a distinct species based on examination of several samples.

Distribution: Cited for the Weddell Sea (GRIFFITHS ET AL., 2003); South Shetland Islands (DELL, 1990), Peter I Island and off Thurston Island (new records), Ross Sea (SMITH, 1907a; DELL, 1990), Cape Adare (SMITH, 1902), Balleny Islands (DELL, 1990), Davis Sea (THIELE, 1912) and Kerguelen Islands (TRONCOSO ET AL., 2001); from 40 m (TRONCOSO ET AL., 2001) to 1890 m (DELL, 1990).

Genus *Pseudamauropsis* Egorova, 2007

Pseudamauropsis anderssoni (Strebel, 1906) (Fig. 30)

Natica anderssoni Strebel, 1906: 142, pl. 11, figs. 67a-b; 1908: 61, pl. 5, figs. 64a-b.

Amauropsis anderssoni: Powell, 1951: 116, pl. 10, figs. 58-59, J44 (radula); Castellanos and Landoni, 1990: 19, pl. 3, fig. 34; Dell, 1990: 140, figs. 245, 265 (radula); Branch *et al.*, 1991: 57 (key); Pastorino, 2005: 252, figs. 102-113; Zelaya, 2005: 120, fig. 26.
Pseudamauropsis anderssoni: Egorova, 2007: figs. 2d, 6v (radula), 7-1 (map), table 1.
Amauropsis powelli Dell, 1990: 144, figs. 246, 268 (radula); Zelaya, 2005: 120.
Pseudamauropsis powelli: Egorova, 2007: figs. 2e, 7-6 (map), table 1.

Material studied: 2 sh. (8.6 x 8.6 - 8.8 x 8.5 mm), PI6; 1 spm. (9.0 x 8.2 mm), PI7; 2 sh. and 1 spm. (8.0 x 8.0 - 8.2 x 8.0 mm), PA25.

Remarks: The deep and narrow open umbilicus, partially occluded by the parietal callus, marks the difference with the other species of the genus. DELL (1990) described *A. powelli* based on the open umbilicus, but PASTORINO (2005) presented a pattern of variation in samples from the same geographic locations as Dell's specimens, concluding that *A. powelli* is a junior synonym of *P. anderssoni*. EGOROVA (2007) described the genus *Pseudamauropsis* based on morphometric analyses and comparisons of the morphospecies *Natica prasina* Watson, 1881, *N. suturalis* Watson, 1881, *N. anderssoni* Strebel, 1908, *N. aureolutea* Strebel, 1908, *N. georgiana* Strebel, 1908, *N. subpallescens* Strebel, 1908, *N. godfroyi* Lamy, 1910, *Lunatia? bransfieldensis* Preston, 1916, *Amauropsis? rossiana* Smith, 1907 and *A. powelli* Dell, 1990 with the northern hemisphere species *Amauropsis islandica* (Gmelin, 1791), situating the species under this new genus and removing it from the genus *Amauropsis* Mörch, 1857. However, her study did not consider the previous revision of the group (PASTORINO, 2005).

Distribution: South Georgia Island (STREBEL, 1908; POWELL, 1951; DELL, 1990; ZELAYA, 2005), Falkland/Malvinas Islands (STREBEL, 1906; STREBEL, 1908; DELL, 1990), Western Antarctic Peninsula and Peter I Island (new records), and Marion and Prince Edward Islands (BRANCH *ET AL.*, 1991); from 12 m (STREBEL, 1908) to 578 m (DELL, 1990).

Pseudamauropsis aureolutea (Strebel, 1908) (Fig. 31)

Natica aureolutea Strebel, 1908: 63, pl. 5, figs. 63a-b.
Amauropsis aureolutea: Powell, 1951: 116, fig. J42 (radula); Dell, 1990: 142, figs. 251, 266 (radula); Pastorino, 2005: 253, figs. 114-123; Zelaya, 2005: 120, fig. 27.
Pseudamauropsis aureolutea: Egorova, 2007: figs. 2v, 3a-v, 5g (operculum), 6a (radula), 7-2 (map), table 1.
Natica subpallescens Strebel, 1908: 62, pl. 5, fig. 67.
Pseudamauropsis subpallescens: Egorova, 2007: fig. 7-10 (map), table 1.
Natica georgiana Strebel, 1908: 62, pl. 5, fig. 65a-b.
Amauropsis georgianus: Powell, 1951: 117; Castellanos and Landoni, 1990: 20, pl. 3, fig. 29g; Numanami, 1996: 109, figs. 70A-B, C (radula); Zelaya, 2005: 120.
Pseudamauropsis georgianus: Egorova, 2007: figs. 5e (operculum), 7-4 (map), table 1.
Natica godfroyi Lamy, 1910a: 322; 1911a: 12, pl. 1, figs. 10-11.
Pseudamauropsis godfroyi: Egorova, 2007: fig. 7-5 (map), table 1.
Lunatia bransfieldensis Preston, 1916: 270, fig. 2.
Pseudamauropsis bransfieldensis: Egorova, 2007: fig. 7-3 (map), table 1.
? *Natica xantha* Watson: Lamy, 1911b: 23, fig. 1 (no Watson, 1881).
Amauropsis rossiana Smith: Hain, 1990: 49, pl. 3, figs. 3a-b, pl. 20, fig. 8 (radula), pl. 21, fig. 1 (radula) (no Smith, 1907).

Material studied: 3 spm. (15.0 x 14.6 - 18.0 x 16.9 mm), PI8; 1 sh. (13.1 x 12.1 mm), MB11; 1 spm. (11.1 x 10.1 mm), PA20; 1 spm. (8.5 x 8.0 mm), MB37; 1 spm. (13.5 x 13.0 mm), MB38; 1 spm. (13.0 x 11.4 mm), PA39; 11 spm. (8.2 x 8.0 - 24.1 x 22.1 mm), LOW.

Remarks: The similar *A. rossiana* Smith, 1907 differs in having a higher spire and a spiral rib on the penultimate whorl. PASTORINO (2005) considered STREBEL's (1908) species *Natica subpallescens* and *N. georgiana* as junior synonyms, because all species, including *N. aureolutea*, were described from juvenile specimens with few significant differences; also he suspected that the little-known *N. godfroyi* Lamy, 1910 and *Lunatia? bransfieldensis* Preston, 1916 might be junior synonyms as well, and reported the misidentification of some specimens as *Falsilunatia xantha* (Watson, 1881) and as *A. rossiana* Smith, 1907 (see PASTORINO, 2005).

Distribution: Widespread West distribution in the South Sandwich (POWELL, 1951; DELL, 1990), South Georgia (STREBEL, 1908; POWELL, 1951; DELL, 1990; PASTORINO, 2005; ZELAYA, 2005) and South Orkney Islands (DELL, 1990), Weddell Sea (HAIN, 1990) and Eastern Antarctic Peninsula (STREBEL, 1908), South Shetland Islands (LAMY, 1911a; PRESTON, 1916; POWELL, 1951; DELL, 1990; this study), Western Antarctic Peninsula, Bellingshausen Sea and Peter I Island (new records), and 34° E and 24° E (NUMANAMI, 1996); from 6 m (STREBEL, 1908) to 1324 m (new record).

Family EPITONIIDAE Berry, 1910
Genus *Acirsa* Mörch, 1857

Acirsa antarctica (Smith, 1907) (Fig. 32)

Scala antarctica Smith, 1907a: 8, pl. 1, figs. 10-10b.
Epitonium antarcticum: Smith, 1915: 64.
Acirsa antarctica: Powell, 1951: 115; 1957: 131; 1958: 187; Dell, 1990: 123, fig. 203.

Material studied: 1 spm. (8.6 x 3.3 mm), MB32.

Remarks: Its generic placement is uncertain, because it has been cited as *Acirsa*, but NEVILLE (1997) located it in the genus *Opalia* H. and A. Adams, 1853. Comparisons with other epitoniids reveal that it differs from the similar species *A. annectens* Powell, 1951 in having a strong sculpture but a weaker basal rib.

Distribution: Bellingshausen Sea (new record), Ross Sea (SMITH, 1907a; SMITH, 1915; POWELL, 1951; DELL, 1990), Kerguelen Islands (POWELL, 1957), Crozet Islands (GRIFFITHS *ET AL*., 2003) and Enderby Land (POWELL, 1958); from 8 m (DELL, 1990) to 1847 m (new record).

Family EULIMIDAE Troschel, 1853
Genus *Hemiaclis* Sars, 1878

Hemiaclis incolorata (Thiele, 1912) (Fig. 33)

Alaba incolorata Thiele, 1912: 201; pl. 12, fig. 19; Egorova, 1982: 31, fig. 145.
Hemiaclis incolorata: Dell, 1990: 128, figs. 213-216; Numanami, 1996: 129, fig. 80F; Engl, 2004a: 11, fig. 1.

Material studied: 1 spm. (4.1 x 1.9 mm), PA39.

Remarks: Comparisons revealed that this species has no related ones in the Southern Ocean, as shown in the well developed discussion by ENGL (2004a).

Distribution: Weddell Sea and South Sandwich Islands (ENGL, 2004a), South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (new record), Ross Sea

(Dell, 1990), Davis Sea (Thiele, 1912; Egorova, 1982), *ca.* 40° E (Griffiths *et al.*, 2003) and 24° E (Numanami, 1996); from 157 m (new record) to 1437 m (Dell, 1990).

Genus *Melanella* Bowdich, 1822

Melanella antarctica (Strebel, 1908) (Fig. 34)

Eulima antarctica Strebel, 1908: 65, pl. 6, figs. 91a-c; Melvill and Standen, 1912: 353; Thiele, 1912: pl. 12, fig. 30.
Balcis antarctica: Powell, 1951: 113; Castellanos, 1990: 27, pl. 3, fig. 27; Hain, 1990: 45, pl. 2, figs. 9a-b.
Melanella antarctica: Engl, 2004a: 12, fig. 3.

Material studied: 4 spm. (3.9 x 1.3 - 4.1 x 1.6 mm), PI8; 1 spm. (broken), MB13; 1 spm. (3.5 x 1.7 mm), PA22; 7 spm. (1.6 x 0.7 - 3.6 x 1.1 mm), MB38.

Remarks: Engl (2004a) studied Antarctic *Melanella* species, not concluding on the affinity between this species and the similar species *M. subantarctica* (Strebel, 1908) from South Georgia Island, that possesses a higher spire similar to *M. convexa* (Smith, 1907). Other Antarctic species such as *M. solitaria* (Smith, 1915) and *M. exulata* (Smith, 1915) differ in having the columellar axis arched; *M. boscheineni* Engl, 2004, *M. sankurieae* Engl, 2004 and *M. tumidula* (Thiele, 1912) differ in having a higher and narrow spire with more whorls; and *M. guenteri* Engl, 2004 is a conic and shiny species with flat whorls.

Distribution: South Sandwich Islands (Powell, 1951), Weddell Sea (Hain, 1990), Eastern Antarctic Peninsula (Strebel, 1908), South Shetland Islands (Engl, 2004a), Burdwood Bank (Melvill and Standen, 1912), Western Antarctic Peninsula, Bellingshausen Sea and Peter I Island (new records); from 90 m (new record) to 5194 m (Engl, 2004a).

Family Cerithiopsidae H. and A. Adams, 1854

Genus *Cerithiopsilla* Thiele, 1912

Cerithiopsilla antarctica (Smith, 1907) (Fig. 35)

Lovenella antarctica Smith, 1907a: 10, pl. 2, fig. 6-6a; Hedley, 1911: 5.
Cerithiopsilla antarctica: Thiele, 1912: 205, pl. 12, fig. 28; Smith, 1915: 70; Hedley, 1916: 49; Powell, 1958: 186; Egorova, 1982: 33, figs. 151-152.

Material studied: 1 spm. (6.0 x 2.1 mm), PA22.

Remarks: Several species of this genus and of some related ones (e.g.. *Cerithiella* Verrill, 1882) described from the Southern Ocean, reveal the limitations of any taxonomic revision. *Cerithiopsilla bisculpta* (Strebel, 1908), *C. charcoti* (Lamy, 1906) and *C. cincta* Thiele, 1912 are the most similar species to *C. antarctica*, and they share a common pattern of sculpture with 3-4 spiral cords crossed by axial striae, therefore an examination and comparison of type specimens will reveal the taxonomic status of these species. *Cerithiopsilla gaussiana* Egorova, 1972 lacks axial sculpture; *C. austrina* (Hedley, 1911), *C. liouvillei* (Lamy, 1910) and *C. georgiana* (Pfeffer, 1886) differ in having only two spiral cords; and *C. burdwoodiana* (Melvill and Standen, 1912) is distinguished by its granulose surface. Strebel (1908) and Thiele (1912) have situated a considerable number of species in the genus *Cerithiella*, which

differs in having a smooth, stout and bulging protoconch of about two whorls.

Distribution: Western Antarctic Peninsula (new record), Ross Sea (SMITH, 1907a; HEDLEY, 1911; SMITH, 1915), Commonwealth (HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982) and Enderby Land (POWELL, 1958); from 45 to 500 m (EGOROVA, 1982).

Cerithiopsilla austrina (Hedley, 1911) (Fig. 36)

Lovenella austrina Hedley, 1911: 5, pl. 1, fig. 7.
Cerithiopsilla austrina: Thiele, 1912: 205, pl. 12, fig. 29; Powell, 1958: 186; Arnaud, 1972: 122; Egorova, 1982: 34, fig. 153.

Material studied: 2 spm. (6.1 x 2.2 - 6.6 x 2.1 mm), MAR.

Remarks: It is very similar to *Cerithiella erecta* Thiele, 1912, but the species of that genus have a smooth and bulbose protoconch.

Distribution: Weddell Sea *ca.* 10° W (GRIFFITHS *ET AL.*, 2003), Western Antarctic Peninsula (new record), Ross Sea (HEDLEY, 1911; ARNAUD, 1972) to Terre Adélie (ARNAUD, 1972), Davis Sea (THIELE, 1912; EGOROVA, 1982) and Enderby Land (POWELL, 1958); from 0 m (ARNAUD, 1972) to 385 m (EGOROVA, 1982).

Family MURICIDAE Rafinesque, 1815
Genus *Trophon* Montfort, 1810

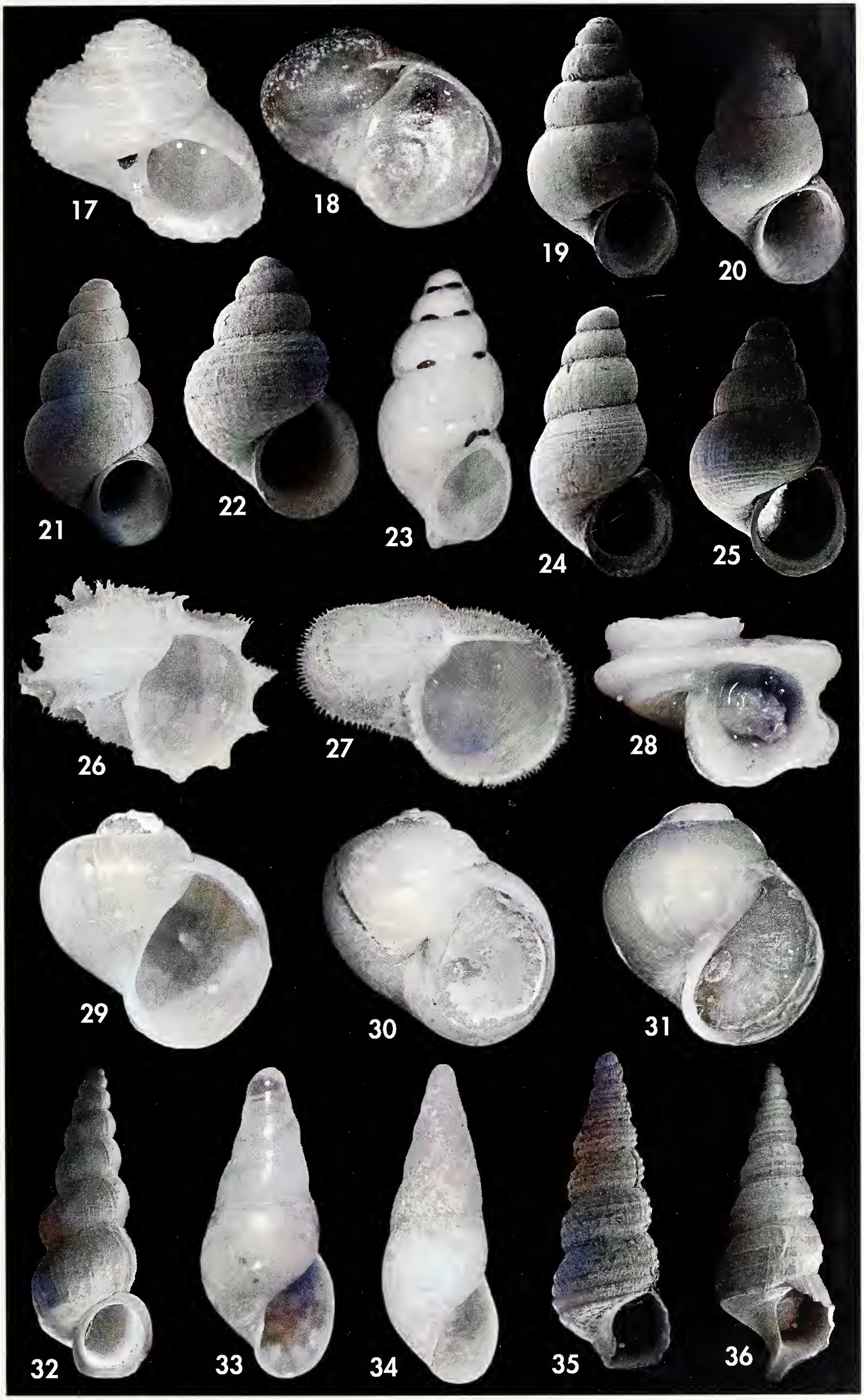
Trophon coulmanensis coulmanensis Smith, 1907 (Fig. 37)

Trophon coulmanensis Smith, 1907a: 3, pl. 1, figs. 4-4b; Thiele, 1912: 212; Smith, 1915: 73, pl. 1, fig. 14; Hedley, 1916: 61, pl. 9, fig. 99; Cernohorsky, 1977: 115, fig. 14; Egorova, 1982: 38, fig. 168; Dell, 1990: 201, figs. 356-359.

Material studied: 1 spm. (17.8 x 12.0 mm), PA22.

Remarks: The higher spire and a little expanded external lip, giving a pyriform aperture and less globose form, mark the difference with *T. shackletoni paucilamellatus* Powell, 1951. NUMANAMI (1996) described the subspecies *T. coulmanensis multilamellatus* from East Antarctica, based on the different

(Right page) Figure 17. *Leptocollonia innocens*, 6.0 x 6.3 mm, MB37. Figure 18. *Dickdellia labioflecta*, 2.9 x 3.4 mm, PA22. Figure 19. *Eatoniella glacialis*, 2.8 x 1.9 mm, PA21. Figure 20. *Eatoniella kerguelenensis regularis*, 3.5 x 2.0 mm, PA20. Figure 21. *Eatoniella* cf. *kerguelenensis kerguelenensis*, 2.8 x 1.5 mm, PA39. Figure 22. *Onoba gelida*, 2.2 x 1.6 mm, PI8. Figure 23. *Onoba kergueleni*, 3.0 x 1.4 mm, PI8. Figure 24. *Onoba turqueti*, 2.1 x 1.1 mm, PI5. Figure 25. *Powellisetia deserta*, 2.5 x 1.5 mm, PA41. Figure 26. *Torellia insignis*, 16.9 x 21.0 mm, LOW. Figure 27. *Torellia mirabilis*, 22.0 x 30.0 mm, PA39. Figure 28. *Torellia planispira*, 4.0 x 5.8 mm, PA24. Figure 29. *Falsilunatia delicatula*, 4.6 x 4.7 mm, PI8. Figure 30. *Pseudamauropsis anderssoni*, 8.6 x 8.6 mm, PI6. Figure 31. *Pseudamauropsis aureolutea*, 15.9 x 14.0 mm, PI8. Figure 32. *Acirsa antarctica*, 8.6 x 3.3 mm, MB32. Figure 33. *Hemiaclis incolorata*, 4.1 x 1.9 mm, PA39. Figure 34. *Melanella antarctica*, 3.9 x 1.3 mm, PI8. Figure 35. *Cerithiopsilla antarctica*, 6.0 x 2.1 mm, PA22. Figure 36. *Cerithiopsilla austrina*, 6.1 x 2.2 mm, MAR.
(Página derecha) Figuras 17-36. Ver los nombres científicos en el rótulo en inglés.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number of lamellae, and he commented that the species *T. coulmanensis* (*s.s.*) "having no expansion in basal varices"; therefore the BENTART samples, that do not have expansion, correspond to subspecies *T. coulmanensis coulmanensis*. Although our individual is not as elongate as the holotype, which has a D/H ratio of 0.54, HEDLEY (1916) reported a specimen with a ratio of 0.67, the same as our specimen, indicating variability in D/H ratio.

Distribution: South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (new record), Ross Sea (SMITH, 1907a; DELL, 1990), 163° E (SMITH, 1915), Terre Adélie (HEDLEY, 1916), Davis Sea (THIELE, 1912; DELL, 1990) and Kerguelen Islands (DELL, 1990); from 183 m (SMITH, 1907a) to 1674 m (DELL, 1990).

Trophon cuspidarioides Powell, 1951 (Fig. 38)

Trophon cuspidarioides Powell, 1951: 155, pl. 9, figs. 50, M89; Castellanos and Landoni, 1993a: 7, pl. 2, fig. 25; Pastorino, 2002: 359 (text), figs. 35-37, 43b, tab. 1; Zelaya, 2005: 122.

Material studied: 3 spm. (15.0 x 6.5 - 18.3 x 7.4 mm), PI7.

Remarks: Its resemblance to some Antarctic species with a long siphon was discussed by PASTORINO (2002), in this sense *T. scolopax* Watson, 1882 presents a longer and straighter siphon, *T. septus* Watson, 1882 presents more conspicuous lamellae and *T. arnaudi* Pastorino, 2002, though similar by its curved siphon, differs in having a reticulated surface with spiral and axial lamellae. Moreover, some specimens of *T. drygalskii* Thiele, 1912 (see below) with a long siphon, may resemble it, but the sculpture and a more angulose shape make that species different. Sub-Antarctic species with similar shape were compared by HOUART AND SELLANES (2006), where *T. veronicae* Pastorino, 1999 and *T. condei* Houart, 2003, described from larger specimens, have a higher spire, and *T. vangoethemi* Houart, 2003 can have abapical lamellae on shoulders.

Distribution: Only reported from South Georgia Island between 120 and 204 m (POWELL, 1951) and Peter I Island at 410 m (new records).

Trophon drygalskii Thiele, 1912 (Fig. 39)

Trophon drygalskii Thiele, 1912: 213, pl. 13, fig. 25; Smith, 1915: 73; Powell, 1958: 197; Egorova, 1982: 38, fig. 165; Dell, 1990: 203, figs. 354-355; Hain, 1990: 62, pl. 6, fig. 8, pl. 25, fig. 1; Numanami, 1996: 131, figs. 85A-C, D (radula).

Material studied: 3 spm. (3.2 x 1.6 - 11.9 x 5.2 mm), MB30; 2 spm. (7.0 x 3.1 - 12.1 x 5.0 mm), MB31.

Remarks: Spiral ridges give the whorls a shape which is not globose, but with an angular shoulder, separating this species from others with a long siphon.

Distribution: Weddell Sea (HAIN, 1990), South Shetland Island and Western Antarctic Peninsula (DELL, 1990), Bellingshausen Sea (new record), Ross Sea (SMITH, 1915; DELL, 1990), Davis Sea (THIELE, 1912), Enderby Land (POWELL, 1958), *ca.* 40° E (GRIFFITHS *ET AL.*, 2003) and 24° E (NUMANAMI, 1996); from 193 m (POWELL, 1958) to 1814 m (new record).

Trophon echinolamellatus Powell, 1951 (Fig. 40)

Trophon echinolamellatus Powell, 1951: 152, pl. 9, figs. 44-45, L83 (radula).

Material studied: 1 spm. (65.1 x 37.2 mm), LOW.

Remarks: The fusiform shape with the anterior aperture expanded and a sculpture with flat-spiral cords crossed by dense axial lamellae, sinuate exactly above the crossing with the spiral cord "produced into hollow recurved spines" (POWELL, 1951), give a particular surface and shape which are distinct from other species with fine lamellae such as *T. geversianus* (Pallas, 1774), from the southern end of South America.

Distribution: Only reported in the South Shetland Islands (POWELL, 1951; this study); from 115 m (new record) to 342 m (POWELL, 1951).

Trophon longstaffi Smith, 1907 (Fig. 41)

Trophon longstaffi Smith, 1907a: 3, pl. 1, figs. 3-3d; Hedley, 1911: 8; Smith, 1915: 73; Hedley 1916: 61; Eales, 1923: 31, figs. 31-33; Arnaud, 1972: 131; Cernohorsky, 1977: 116, fig. 16; Dell, 1990: 205, figs. 351-352; Numanami, 1996: 134, figs. 87A-C, D (radula).

Material studied: 2 spm. (9.0 x 6.4 - 13.3 x 9.0 mm), PI5; 2 spm. (18.1 x 11.0 - 21.0 x 13.0 mm), PI8.

Remarks: Axial lamellae are shorter, thinner and more fragile than in *T. shackletoni shackletoni* Hedley, 1911, which is similar in shape, but with more conspicuous lamellae, prolonged on shoulders.

Distribution: Cited for the Weddell Sea (GRIFFITHS *ET AL*., 2003), Eastern Antarctic Peninsula (SMITH, 1907a), Peter I Island (new record), Ross Sea (HEDLEY, 1911; SMITH, 1915; DELL, 1990), Commonwealth (HEDLEY, 1916), Terre Adélie (HEDLEY, 1916; ARNAUD, 1972) and 40° E (NUMANAMI, 1996); from 5 m (ARNAUD, 1972; NUMANAMI, 1996) to 1080 m (DELL, 1990).

Trophon minutus Strebel, MS. Melvill and Standen, 1907 (Fig. 42)

Trophon minutus Strebel, MS. Melvill and Standen, 1907: 137, figs. 7-7a; Strebel, 1908: 44, pl. 4, figs. 47a-b; Melvill and Standen, 1912: 354; Powell, 1951: 155; Oliver and Picken, 1984: 113, figs. 33a-b; Dell, 1990: 203, fig. 353; Castellanos and Landoni, 1993a: 13, pl. 4, fig. 48; Zelaya, 2005: 122.
Trophon condensatus Hedley, 1916: 60, pl. 9, fig. 98; Arnaud, 1972: 131, fig. 21.

Material studied: 1 sh. (4.5 x 3.0 mm), PA20.

Remarks: Assuming the synonymy of *T. condensatus* Hedley, 1916 proposed by DELL (1990), the number of axial lamellae is widely variable, as same as other species of the genus.

Distribution: Cited for the Weddell Sea (GRIFFITHS *ET AL*., 2003), South Sandwich (DELL, 1990), South Georgia (STREBEL, 1908), South Orkney (MELVILL AND STANDEN, 1907), Signy (OLIVER AND PICKEN, 1984) and South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (POWELL, 1951; DELL, 1990; this study), Ross Sea (DELL, 1990), Commonwealth (HEDLEY, 1916), Terre Adélie (ARNAUD, 1972) and Kerguelen Islands (CANTERA AND ARNAUD, 1985); from 2 m (OLIVER AND PICKEN, 1984) to 265 m (DELL, 1990).

Family BUCCINIDAE Rafinesque, 1815
Genus *Antarctodomus* Dell, 1972

Antarctodomus thielei (Powell, 1958) (Fig. 43)

Bathydomus thielei Powell, 1958: 194, pl. 3, fig 8; Arnaud, 1972: 129, fig. 20.
Antarctodomus thielei: Dell, 1990: 168; Hain, 1990: 57, pl. 5, fig. 7, pl. 23, fig. 4 (radula); Numanami, 1996: 147, figs. 96A-C, D (radula).

Material studied: 2 spm. (29.2 x 18.5 - 36.1 x 22.0 mm), LOW.

Remarks: This species is variable in shape (DELL, 1990), and specimens collected over several expeditions presented a wide variation in diameter/height ratio (D/H): 0.56 in holotype, 0.60 in a specimen from Dell (1990), 0.59 in HAIN's (1990) specimen and 0.64 in NUMANAMI's (1996) specimen. *Antarctodomus okutanii* Numanami, 1996, variable in D/H ratio as well, was described based on radular characteristics.

Distribution: Weddell Sea (HAIN, 1990), South Shetland Islands (new record), Ross Sea (DELL, 1990), Terre Adélie (ARNAUD, 1972), Mac Robertson Land (DELL, 1990), Enderby Land (POWELL, 1958), cited *ca.* 40° E (GRIFFITHS *ET AL.*, 2003) and 24° E (NUMANAMI, 1996); from 100 m (DELL, 1990) to 695 m (HAIN, 1990).

Genus *Chlanidota* Martens, 1878

Chlanidota signeyana Powell, 1951 (Fig. 44)

Chlanidota signeyana Powell, 1951: 141, pl. 8, figs. 34-35, L74 (radula), N129 (operculum); Dell, 1990: 177, fig. 307; Harasewych and Kantor, 1999: 267, figs. 9-11, table 5.
Cominella vestita var. *elongata* Lamy, 1910a: 318; 1911a: 6, pl. 1, fig. 6.
Chlanidota elongata: Powell, 1951: 140, fig. L76 (radula); Cernohorsky, 1977: 110; Hain, 1990: 55, pl. 5, fig. 4, pl. 23, fig. 1 (radula); Numanami, 1996: 160, figs. 106A- F, G-H (radula); Numanami *et al.*, 1996: 211-212 (tables), 213 (text), pl. 2, figs. 3-4.
Chlanidota lamyi Dell, 1990: 182, fig. 310 (*nom. nov.* for *Cominella vestita* var. *elongata* Lamy, 1910, not *Cominella elongata* Dunker, 1857).
Chlanidota cf. *lamyi*: Dell, 1990 182, fig. 315.
Chlanidota pyriformis Dell, 1990: 182, fig. 309.

Material studied: 8 spm. (8.4 x 5.6 - 34.2 x 21.2 mm), PI5; 5 spm. (23.1 x 16.0 - 28.2 x 18.0 mm), PI6; 2 spm. (12.0 x 9.0 - 26.2 x 16.1 mm), PI7; 1 spm. (19.4 x 11.3 mm), MB13; 4 spm. (22.3 x 12.9 - 32.9 x 20.2 mm), PA24; 2 spm. (27.5 x 17.1 - 29.0 x 17.8 mm), PA25; 24 spm. (14.4 x 9.6 - 25.0 x 15.3 mm), MB34; 1 spm. (20.7 x 11.8 mm), PA39; 1 spm. (19.0 x 13.2 mm), PA40; 5 spm. (12.5 x 9.0 - 22.0 x 14.2 mm), LOW.

Remarks: HARASEWYCH AND KANTOR (1999) have revised the genus and synonymized many species; also they comment that in examination of individuals, some are strongly sculptured with pilose projections on the spiral cords, but these specimens differ from *C. pilosa* Powell, 1951 in not having a densely pilose periostracum. This is a variable species in shape, there are some very thin individuals with a thin columellar callus, and others which are very thick with a well developed columellar callus, resembling therefore *C. invenusta* Harasewych and Kantor, 1999, which differs in having a larger operculum.

Distribution: Cited *ca.* the South Sandwich Islands (GRIFFITHS *ET AL.*, 2003); South Georgia Island (DELL, 1990), Weddell Sea (DELL, 1990; HAIN, 1990), South Orkney (POWELL, 1951; DELL, 1990), Signy (DELL, 1990) and South Shetland Islands (LAMY, 1911a; POWELL, 1951; DELL, 1990; this study), Western Antarctic Peninsula (DELL, 1990; this study), Bellingshausen Sea and Peter I Island (new records), Ross Sea (DELL, 1990), Enderby Land and Syowa (NUMANAMI *ET AL.*, 1996), 24° E (NUMANAMI, 1996) and Queen Maud (HARASEWYCH AND KANTOR, 1999); from 10 m (HAIN, 1990) to 1116 m (DELL, 1990).

Genus *Lusitromina* Harasewych and Kantor, 2004

Lusitromina abyssorum (Lus, 1993) (Fig. 45)

Tromina abyssorum Lus, 1993: 178.
Lusitromina abyssorum: Harasewych and Kantor, 2004: 26, figs. 99-137, table 5.

Material studied: 1 spm. (9.0 x 6.1 mm), MB26.

Remarks: HARASEWYCH AND KANTOR (2004) have revised the genus and they also placed *L. abyssicola* (Clarke, 1961) (described as *T. bella abyssicola*) from the South Atlantic Ocean in this genus. *L. abyssicola* differs in having a more rounded shape with more convex whorls without the characteristic shoulder of *L. abyssorum*.

Distribution: Known only from the South Sandwich and South Georgia Islands (HARASEWYCH AND KANTOR, 2004), South Orkney (LUS, 1993), Southeast of Tierra del Fuego Island (56° S, 62° W) (HARASEWYCH AND KANTOR, 2004) and Bellingshausen Sea (new record); from 1920 m (new record) to 5480 m (HARASEWYCH AND KANTOR, 2004).

Genus *Neobuccinum* Smith, 1879

Neobuccinum eatoni (Smith, 1875) (Fig. 46)

Buccinopsis eatoni Smith, 1875: 68.
Neobuccinum eatoni: Smith, 1879: 169, pl. 9, fig. 1; Watson, 1886: 216; Smith, 1902: 202; Lamy, 1906b: 2; Smith, 1907a: 1; Melvill and Standen, 1907: 139; Hedley, 1911: 6, pl. 1, figs. 11, 12 (eggs); Lamy, 1911a: 5; Thiele, 1912: 248; Smith, 1915: 72; Hedley, 1916: 59, pl. 9, fig. 97; Eales, 1923: 28; Powell, 1951: 143; Powell, 1957: 132; 1958: 193; Arnaud, 1972: 128; Egorova, 1982: 41, figs. 51 (radula), 172-176; Dell, 1990: 165, figs. 280-282; Hain 1990: 56, pl. 5, figs. 6a-e, pl. 23, fig. 3 (radula); Numanami, 1996: 143, figs. 94A-B, D-G, C (radula); Numanami *et al.*, 1996: 211-212 (tables), 214 (text), pl. 2, fig. 2; Troncoso *et al.*, 2001: 97, fig. 19.
Neobuccinum eytoni (sic): Thiele, 1912: 211.
Neobuccinum praeclarum Strebel, 1908: 31, pl. 3, figs. 38a-g.
Chlanidota smithi Powell, 1958: 192, pl. 3, fig. 3; Harasewych and Kantor, 1999: 291: fig. 27.

Material studied: 2 spm. (28.0 x 15.0 - 40.0 x 25.0 mm), MB1; 6 spm. (35.0 x 20.0 - 53.0 x 30.0 mm), PI5; 2 spm. (48.0 x 29.1 - 51.5 x 32.5 mm), PI6; 51 spm. (31.3 x 20.0 - 55,9 x 33.9 mm), PI8; 1 spm. (31.8 x 22.1 mm), MB13; 20 spm. (36.0 x 21.5 - 54.2 x 27.7 mm), PA22; 7 spm. (34.8 x 22.0 - 49.1 x 29.8 mm), PA23.

Remarks: Although it is variable in shape, this is a well known species. HEDLEY (1916) maintained that *N. preclarum* Strebel, 1908 is a junior synonym, because it was described based on the variability of some specimens that may have spiral lines. Furthermore, HARASEWYCH AND KANTOR (1999) considered *Chlanidota smithi* Powell, 1958 as another junior synonym.

Distribution: Widespread Antarctic and Sub-Antarctic distribution, but not cited for the South Georgia Island nor the Magellanic zone. Reported in the South Sandwich (POWELL, 1951; DELL, 1990), South Orkney (MELVILL AND STANDEN, 1907; DELL, 1990) and Signy Islands (DELL, 1990), Weddell Sea (HAIN, 1990) and Eastern Antarctic Peninsula (STREBEL, 1908), South Shetland Islands (Powell, 1951; Dell, 1990) and Western Antarctic Peninsula (LAMY, 1906b, 1911a; DELL, 1990; this study), Bellingshausen Sea (LAMY, 1911a; this study) and Peter I Island (DELL, 1990; this study), off Thurston Island (new record), Ross Sea (SMITH, 1915; EALES, 1923; POWELL, 1951; DELL, 1990), Cape Adare (SMITH, 1902),

Balleny Islands (Dell, 1990), Commonwealth (Hedley, 1916), Terre Adélie (Arnaud, 1972), Shackleton Ice Shelf (Hedley, 1916), Davis Sea (Thiele, 1912; Egorova, 1982), Heard (Watson, 1886) and Kerguelen Islands (Smith, 1879; Watson, 1886; Powell, 1957; Troncoso *et al.*, 2001), Kemp Land (Powell, 1958), Enderby Land (Numanami *et al.*, 1996) and Syowa (Numanami, 1996; Numanami *et al.*, 1996); from 4 to 2350 m (Dell, 1990).

Genus *Notoficula* Thiele, 1917

Notoficula bouveti (Thiele, 1912) (Fig. 47)

Cominella bouveti Thiele, 1912: 270, pl. 19, fig. 13.
Notoficula bouveti: Powell, 1958: 193; Oliver, 1983: 4 (in part), figs. 1d-e; Dell, 1990: 168, fig. 287.

Material studied: 1 spm. (11.2 x 8.7 mm), LOW.

Remarks: Oliver (1983) discussed the systematic position of this genus in Antarctica, the affinities between species and its relationship with Lamellariacea. The species *N. signyensis* Oliver, 1983, differs in having a more globose last whorl, with a broader aperture and a shorter spire.

Distribution: Cited *ca.* 10° W (Griffiths *et al.*, 2003); South Shetland Islands (new record), Ross Sea (Dell, 1990), from the Amery Ice Shelf to the Enderby Land (Powell, 1958), and Bouvet Island (Thiele, 1912; Linse, 2006); from 86 m (new record) to 540 m (Powell, 1958).

Genus *Pareuthria* Strebel, 1905

Pareuthria regulus (Watson, 1882) (Fig. 48)

Fusus regulus Watson, 1882: 378; 1886: 204, pl. 12, fig. 7.
Pareuthria regulus: Powell, 1957: 132; Branch *et al.*, 1991: 59 (key); Troncoso *et al.*, 2001: 98, fig. 21.

Material studied: 1 spm. and 1 sh. (6.9 x 3.0 - 8.1 x 3.5 mm), PI5; 1 spm. (6.5 x 3.0 mm), PA39.

Remarks: *P. turriformis* Egorova, 1982, differs in having axial ribs crossed by spiral striae. *P. innocens* (Smith, 1907), differing in having a shorter siphon, being smoother and having a sculpture which is stronger spirally than axially. *P. plicatula* Thiele, 1912 has stronger and denser spiral ribs and no spiral sculpture. *P. hoshiaii* Numanami, 1996 is a species with a poorly developed shell sculpture. Dell (1990) remarked that the little known *P. valdiviae* Thiele, 1925, has an affinity with this species.

Distribution: East Antarctica in the Kerguelen (Watson, 1886; Powell, 1957; Troncoso *et al.*, 2001), Crozet (Griffiths *et al.*, 2003), Marion and Prince Edward Islands (Branch *et al.*, 1991); West Antarctica in Western Antarctic Peninsula and Peter I Island (new records); from 0 to 527 m (Branch *et al.*, 1991).

Genus *Probuccinum* Thiele, 1912

Probuccinum tenerum (Smith, 1907) (Fig. 49)

Neobuccinum tenerum Smith, 1907a: 2, pl. 1, figs. 2-2a; Smith, 1915: 72.

Probuccinum tenerum: Thiele, 1912: 211, pl. 13, figs. 21-21a, pl. 16, fig. 21 (radula); Dell, 1990: 171, figs. 279, 283-284; Hain, 1990: 58, pl. 5, fig. 9, pl. 23, fig. 6 (radula).
Probuccinum tenuistriatum Hedley, 1916: 58, pl. 8, figs. 95-96; Powell, 1958: 194; Egorova, 1982: 42, figs. 52 (radula), 178-179; Hain, 1990: 58, pl. 5, fig. 10, pl. 23, fig. 7 (radula); Numanami, 1996: 157, figs. 104A- G, H (radula); Numanami *et al.*, 1996: 212 (table, text) pl. 2, fig. 10.

Material studied: 1 spm. (17.0 x 8.2 mm), PA25.

Remarks: *Probuccinum delicatulum* Powell, 1951 and *P. angulatum* Powell, 1951 differ in having a straighter spire with slightly convex whorls. The synonymy of *P. tenuistriatum* Hedley, 1916 was proposed by DELL (1990), maintaining that the double labial varix and details of sculpture, the main characteristics of *P. tenuistriatum*, correspond to the characteristic variability and changes through development of the species.

Distribution: Weddell Sea (HAIN 1990), South Orkney and South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (DELL, 1990; this study) and Peter I Island (DELL, 1990), Ross Sea (SMITH, 1907a, 1915; DELL, 1990), Commonwealth (HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982; DELL, 1990), from Amery Ice Shelf to Enderby (POWELL, 1958), Syowa (NUMANAMI *ET AL.*, 1996) and 24° E (NUMANAMI, 1996); from 30 m (NUMANAMI *ET AL.*, 1996) to 673 m (HAIN, 1990).

Genus *Prosipho* Thiele, 1912

Prosipho chordatus (Strebel, 1908) (Fig. 50)

Sipho? chordatus Strebel, 1908: 30, pl. 2, figs. 29a-c.
Prosipho chordatus: Powell, 1951: 146; Dell, 1990: 197 (text), fig. 335; Castellanos, 1992b: 18, pl. 2, fig. 20; Zelaya, 2005: 126, fig. 43.

Material studied: 1 spm. (8.0 x 3.9 mm), PI8.

Remarks: The species *P. spiralis* Thiele, 1912 is very close in shape and sculpture, but it has one whorl less, being slightly shorter and with slightly stronger spiral chords over the entire shell. DELL (1990) discussed the affinity between *P. spiralis* and *P. chordatus*, contending that the two species would require critical comparison when more material is available from closer localities. Also, it has a resemblance with *P. antarctidis* (Pelseneer, 1903) cited for the Bellingshausen Sea, but that species presents wider first whorls.

Distribution: Known only from South Georgia Island (STREBEL, 1908; POWELL, 1951; ZELAYA, 2005) and Peter I Island (new record), although it was cited for the South Atlantic Ocean (CASTELLANOS, 1992b) and Weddell Sea (GRIFFITHS *ET AL.*, 2003). The bathymetric distribution is from 90 m (new record) to 600 m (CASTELLANOS, 1992b). ZELAYA (2005) doubts the presence of this species in the South Atlantic Ocean after comparison of the original description with the specimens figured by CASTELLANOS (1992b) and the lack of these samples in museums.

Prosipho hedleyi Powell, 1958 (Fig. 51)

Prosipho hedleyi Powell, 1958: 195, pl. 2, fig. 7; Dell, 1990: 194, fig. 327.

Material studied: 2 spm. (6.9 x 2.8 - 7.3 x 2.9 mm), PI8.

Remarks: The closest species is *P. turritus* Oliver and Picken, 1984, that differs mainly in having a smaller number of spiral cords at the base (4-5 *vs.* 6-9 in *P. hedleyi*) and being wider in D/H ratio which varies: 0.42-0.53 *vs.* 0.36-0.40 in *P. hedleyi*, according to DELL (1990).

Distribution: Cited *ca.* 10° W in the Weddell Sea (GRIFFITHS *ET AL.*, 2003); Western Antarctic Peninsula (DELL, 1990), Peter I Island (new record), Ross Sea (DELL, 1990) and Enderby Land (POWELL, 1958); from 64 to 472 m (DELL, 1990).

Prosipho hunteri Hedley, 1916 (Fig. 52)

Prosipho hunteri Hedley, 1916: 56, pl. 8, fig. 92; Powell, 1951: 147; Powell, 1958: 196; Arnaud, 1972: 130; Dell, 1990: 194, fig. 322; Hain, 1990: 60, pl. 6, fig. 2, pl. 24, fig. 3 (radula); Numanami, 1996: 165, figs. 110A-B, C (radula); Engl, 2004b: 1 (text), fig. 1; Zelaya, 2005: 126.

Material studied: 2 spm. (5.3 x 2.8 - 5.8 x 3.0 mm), PA39.

Remarks: ENGL (2004b) established that *P. hunteri* may correspond to a variation of *P. nodosus* Thiele, 1912, because both species share the characteristic of two nodulose spiral cords on each whorl and four in the last whorl; He also described *P. enricoi* Engl, 2004, a similar species from the South Shetland Islands, without indicating differences with *P. hunteri*, though he figured its holotype, that is distinguished in having slightly weaker spiral cords than *P. enricoi*. Summarizing, we agree with ENGL (2004b) that a study comparing the material published from several expeditions (THIELE, 1912; HEDLEY, 1916; POWELL, 1951, 1958; ARNAUD, 1972; DELL, 1990; HAIN, 1990; ENGL, 2004b; this study) is necessary to clarify the relationship between *P. hunteri*, *P. nodosus* and *P. enricoi*.

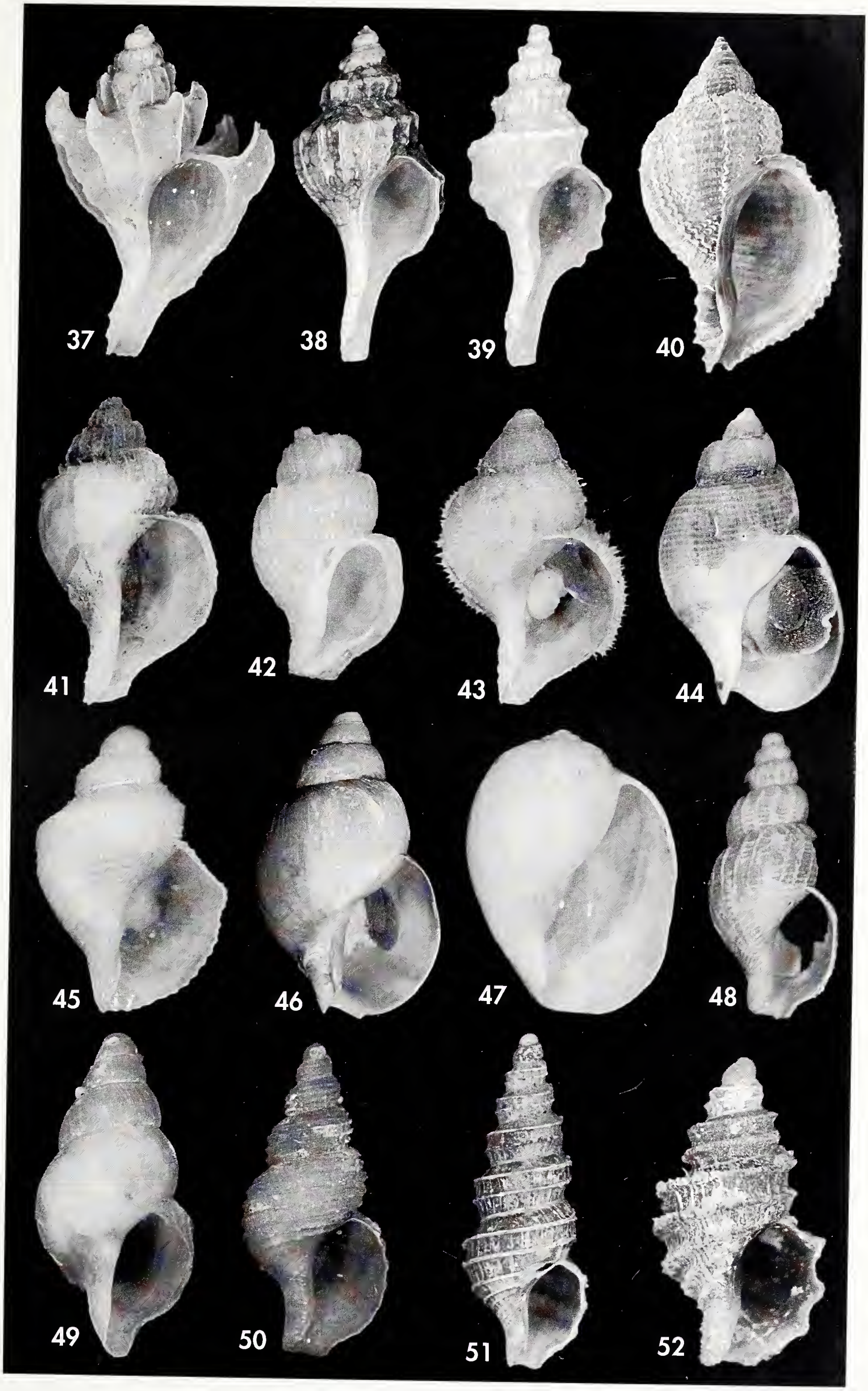
Distribution: Weddell Sea (HAIN, 1990), South Sandwich (DELL, 1990) and South Georgia Islands (POWELL, 1951), South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (DELL, 1990; this study) and Ross Sea (DELL, 1990), Commonwealth (HEDLEY, 1916), Terre Adélie (ARNAUD, 1972), Enderby Land (POWELL, 1958), *ca.* 40° E (GRIFFITHS *ET AL.*, 2003) and 24° E (NUMANAMI, 1996); from 45 m (HAIN, 1990) to 464 m (DELL, 1990).

Prosipho pellitus Thiele, 1912 (Fig. 53)

Prosipho pellitus Thiele, 1912: 245, pl. 13, fig. 9; Powell, 1957: 133; Dell, 1990: 195, fig. 329; Zelaya, 2005: 126, fig. 45.

Material studied: 1 spm. (4.1 x 2.0 mm), PI8.

(Right page) Figure 37. *Trophon coulmanensis coulmanensis*, 17.8 x 12.0 mm, PA22. Figure 38. *Trophon cuspidarioides*, 15.0 x 6.5 mm, PI7. Figure 39. *Trophon drygalskii*, 12.1 x 5.0 mm, MB31. Figure 40. *Trophon echinolamellatus*, 65.1 x 37.2 mm, LOW. Figure 41. *Trophon longstaffi*, 21.0 x 13.0 mm, PI8. Figure 42. *Trophon minutus*, 4.5 x 3.0 mm, PA20. Figure 43. *Antarctodomus thielei*, 29.2 x 18.5 mm, LOW. Figure 44. *Chlanidota signeyana*, 34.2 x 21.2 mm, PI5. Figure 45. *Lusitromina abyssorum*, 9.0 x 6.1 mm, MB26. Figure 46. *Neobuccinum eatoni*, 48.0 x 29.1 mm, PI6. Figure 47. *Notoficula bouveti*, 11.2 x 8.7 mm, LOW. Figure 48. *Pareuthria regulus*, 8.1 x 3.5 mm, PI5. Figure 49. *Probuccinum tenerum*, 17.0 x 8.2 mm, PA25. Figure 50. *Prosipho chordatus*, 8.0 x 3.9 mm, PI8. Figure 51. *Prosipho hedleyi*, 7.3 x 2.9 mm, PI8. Figure 52. *Prosipho hunteri*, 5.3 x 2.8 mm, PA39.
(Página derecha) Figuras 37-52. Ver los nombres científicos en el rótulo en inglés.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Remarks: Its main characteristic is the periostracum developed in conspicuous axial lamellae, which distinguish it from other species similar in shape and sculpture, but not having lamellae - such as *P. hedleyi* Powell, 1958, *P. turritus* Oliver and Picken, 1984, *P. gracilis* Thiele, 1912 and *P. glacialis* Thiele, 1912.

Distribution: Cited *ca.* 10° W from the Weddell Sea (GRIFFITHS *ET AL.*, 2003); South Georgia (DELL, 1990; ZELAYA, 2005), Peter I (new record) and Kerguelen Islands (THIELE, 1912; POWELL, 1957); from 90 m (new record) to 150 m (POWELL, 1957).

Prosipho pusillus Thiele, 1912 (Fig. 54)

Prosipho pusillus Thiele, 1912: 208, pl. 12, fig. 35; Egorova, 1982: 46, figs. 58 (radula), 193; Dell, 1990: 196, fig. 316.

Material studied: 1 spm. (5.0 x 2.5 mm), PI8.

Remarks: *P. crassicostatus* (Melvill and Standen, 1907) and *P. aurora* Hedley, 1916 are similar in shape, but have one whorl more and one spiral cord more per whorl, this being the last spiral cord on the suture.

Distribution: Cited *ca.* 10° W in the Weddell Sea (GRIFFITHS *ET AL.*, 2003); Peter I Island (new record), Ross Sea (DELL, 1990) and Davis Sea (THIELE, 1912; EGOROVA, 1982); from 90 m (new record) to 563 m (DELL, 1990).

Prosipho reversus Powell, 1958 (Fig. 55)

Prosipho reversa Powell, 1958: 197, pl. 2, fig. 6; Dell, 1990: 196, fig. 341.

Material studied: 1 spm. (broken), PA39.

Remarks: Although we only found a fragment of a fresh shell with remains of soft parts, the spiral sculpture of two spiral cords on the penultimate whorl, being the adapical above the base, clearly differenciates this species from *P. perversus* Powell,1951 and *P. contrarius* Thiele, 1912.

Distribution: Known only from the South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (new record) and Enderby Land (POWELL, 1958); from 157 m (new record) to 220 m (POWELL, 1958).

Prosipho turritus Oliver and Picken, 1984 (Fig. 56)

Prosipho turrita Oliver and Picken, 1984: 99, figs. 2a-b, 6a-d; Dell, 1990: 194 (text), fig. 328; Hain, 1990: 61, pl. 6, fig. 4, pl. 24, fig. 5 (radula).

Cerithium georgianum Martens and Pfeffer: Melvill and Standen, 1907: 134 (no Martens and Pfeffer, 1886).

Material studied: 1 spm. (5.6 x 2.4 mm), PA39.

Remarks: OLIVER AND PICKEN (1984) examined individuals assigned to *Cerithium georgianum* Martens and Pfeffer, 1886 by MELVILL AND STANDEN (1907 p. 134), and concluded that those specimens are co-specific with *P. turritus*. The species *P. harrietae* Engl and Schwabe, 2003 has a weaker sculpture and is narrower; also when considering the description of its radular characteris-

tics. *P. hedleyi* Powell is narrower as well (see above for remarks on *P. hedleyi*).

Distribution: Weddell Sea (HAIN, 1990), South Orkney (MELVILL AND STANDEN, 1907) and Signy Islands (OLIVER AND PICKEN, 1984), Western Antarctic Peninsula (new record); from 2 m (OLIVER AND PICKEN, 1984) to 300 m (HAIN, 1990).

Family VOLUTIDAE Rafinesque, 1815
Genus *Harpovoluta* Thiele, 1912

Harpovoluta charcoti (Lamy, 1910) (Fig. 57)

Buccinum charcoti Lamy, 1910a: 318; 1911a: 4, pl. 1, figs. 1-2.
Harpovoluta charcoti: Thiele, 1912: 271; Powell, 1951: 164; Powell, 1958: 199; Dell, 1990: 218, figs. 365-366, 374-375, 383 (radula); Hain, 1990: 64, pl. 6, figs. 10a-d, pl. 25, fig. 3 (radula); Numanami, 1996: 195, figs. 134A- D, F (radula); Numanami *et al.*, 1996: 211-212 (tables), 214 (text), pl. 2, figs. 6-7.
Volutharpa charcoti: Smith, 1915: 72; Eales, 1923: 33
Harpovoluta vanhoeffeni Thiele, 1912: 213, pl. 14, fig. 1; Hedley, 1916: 53; Egorova, 1982: 36, fig. 163.
Harpovoluta vanhoeffeni var. *striatula* Thiele, 1912: 214, pl. 14, fig. 2; Egorova, 1982: 37, figs. 48 (radula), 164.

Material studied: 3 spm. (broken), PA19; 1 spm. (54.8 x 32.0 mm), PA22; 3 spm. (14.0 x 9.0 - 14.3 x 9.2 mm), PA23; 6 spm. (26.3 x 16.1 - 44.1 x 22.1 mm), PA39; 1 spm. (20.0 x 13.1 mm), LOW.

Remarks: Based on the examination of many specimens, DELL (1990) concluded that the variability in shell proportions is definitive to place *H. vanhoeffeni* and *H. vanhoeffeni* var. *striatula* as junior synonyms of *H. charcoti*.

Distribution: South Sandwich Islands (DELL, 1990), Weddell Sea (HAIN, 1990), Scotia Sea and South Orkney Islands (DELL, 1990), South Shetland Islands (LAMY, 1911a; POWELL, 1951; DELL, 1990; this study), Western Antarctic Peninsula (DELL, 1990; this study), Ross Sea (DELL, 1990), 163° E (SMITH, 1915), from Terre Adélie to Wilkes Land and Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982), Amery Ice-Shelf (NUMANAMI ET AL., 1996), Mac Robertson Land (POWELL, 1958), Enderby Land, Syowa (NUMANAMI ET AL., 1996) and 34° E (NUMANAMI, 1996); from 0 m (NUMANAMI ET AL., 1996) to 1469 m (DELL, 1990).

Family CONIDAE Rafinesque, 1815
Genus *Belaturricula* Powell, 1951

Belaturricula ergata (Hedley, 1916) (Fig. 58)

Pontiothauma ergata Hedley, 1916: 55, pl. 8, figs. 85-87; Powell, 1958: 204, pl. 3, figs. 7, C1-4; Egorova, 1982: 50, figs. 63a-b (radula), 204-205; Okutani, 1986: 279 (table), pl. 1, figs. 4-5; Dell, 1990: 245 (text), figs. 397, 418-419; Hain, 1990: 72, pl. 8, figs. 6a-d, pl. 27, fig. 2 (radula); Numanami, 1996: 224, figs. 159A-C, D-E (radula).
Belaturricula ergata: Kantor and Harasewych, 1999: 434 (text).
Pontiothauma elgata (sic): Numanami *et al.*, 1996: 211 (table), 213 (text), pl.3, fig. 3.

Material studied: 1 spm. (18.0 x 7.9 mm), MB1.

Remarks: HEDLEY (1916) described this species from two individuals, one eroded and the other broken, but his description agrees with our specimen. KANTOR AND HARASEWYCH (1999) studied the similar species *B. gaini* (Lamy, 1910) and assigned *B. ergata* to the genus *Belaturricula* because of its

affinity to *B. gaini*, which differs in having convex whorls, different from the concave-convex whorls of *B. ergata*. On the other hand, the shape and proportions of this species seem variable, because the holotype has a D/H ratio of 0.38 while the three specimens figured by HAIN (1990) vary in 0.37-0.51 and those by NUMANAMI (1996) in 0.33-0.40.

Distribution: Weddell Sea (HAIN, 1990), off Thurston Island (new record), Terre Adélie (HEDLEY, 1916), Wilkes Land (POWELL, 1958), Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (EGOROVA, 1982), Mac Robertson Land to Enderby Land (POWELL, 1958), Syowa (NUMANAMI *ET AL.*, 1996) and 24° E (OKUTANI, 1986; NUMANAMI, 1996); from 100 to 695 m (HAIN, 1990).

Belaturricula gaini (Lamy, 1910) (Fig. 59)

Sipho gaini Lamy, 1910a: 319; 1911a: 7, pl. 1, figs. 7-8.
Prosipho? gaini: Thiele, 1912: 262.
?Chlanidota gaini: Powell, 1951: 142.
Chlanidota gaini: Dell, 1990: 177 (text); Harasewych and Kantor, 1999: 293.
Belaturricula gaini: Kantor and Harasewych, 1999: 430, figs. 1-4.
Belaturricula antarctica Dell, 1990: 228, figs. 401, 431 (radula).

Material studied: 1 spm. (20.0 x 8.1 mm), PA23; 2 spm. (15.3 x 6.9 - 53.9 x 19.5 mm), LOW.

Remarks: KANTOR AND HARASEWYCH (1999) redescribed this little known species and examined its alimentary system and radula, concluding that *B. antarctica* Dell, 1990 is a junior synonym. Other species of this genus, *B. turrita turrita* (Strebel, 1908) and *B. turrita multispiralis* Dell, 1990, are differentiated in having a sharper spiral sculpture. The relationship with *B. ergata* (Hedley, 1916) is discussed above (see *B. ergata*).

Distribution: South Sandwich Islands (DELL, 1990), Eastern Antarctic Peninsula (KANTOR AND HARASEWYCH, 1999), South Orkney Islands (DELL, 1990; KANTOR AND HARASEWYCH, 1999), South Shetland Islands (LAMY, 1911a; DELL, 1990; KANTOR AND HARASEWYCH, 1999; this study), Western Antarctic Peninsula (new record) and Ross Sea (DELL, 1990; KANTOR AND HARASEWYCH, 1999); from 97 m (new record) to 759 m (DELL, 1990).

Family TURRIDAE Swainson, 1840
Genus *Aforia* Dall, 1889

Aforia magnifica (Strebel, 1908) (Fig. 60)

?Surcula magnifica Strebel, 1908: 19, pl. 2, figs. 23a-d.
Aforia magnifica: Powell, 1951: 167, fig. M91 (radula); Powell, 1958: 201; Dell, 1990: 231, figs. 411-412, 436 (radula); Hain, 1990: 69, pl. 7, figs. 8a-c, pl. 26, figs. 1-2 (radula); Numanami *et al.*, 1996: 211 (table), 213 (text), pl. 3, figs. 1, 4.

Material studied: 1 spm. (69.0 x 26.0 mm), PA18; 1 spm. (47.9 x 17.5 mm), PA21; 2 spm. (41.8 x 17.5 - 47.0 x 16.1 mm), LOW.

Remarks: The main difference with the similar species *A. multispiralis* Dell, 1990, is in the number of spiral keels per whorl: two sharp keels on the spire whorls in *A. multispiralis* instead of the single rounded carina in *A. magnifica*. DELL (1990) noted the variability of the strength of sculpture between individuals collected at different depths.

Distribution: South Sandwich Islands (POWELL, 1951; DELL, 1990), Weddell Sea (HAIN, 1990) and Eastern Antarctic Peninsula (STREBEL, 1908), South Orkney Islands (DELL, 1990), South Shetland Islands and Western Antarctic Peninsula (POWELL, 1951; DELL, 1990; this study), Ross Sea (DELL, 1990), Amery Ice Shelf to Mac Robertson Land (POWELL, 1958), Syowa (NUMANAMI *ET AL.*, 1996) and *ca.* 10° E (GRIFFITHS *ET AL.*, 2003); from 73 to 1890 m (DELL, 1990).

Aforia multispiralis Dell, 1990 (Fig. 61)

Aforia multispiralis Dell, 1990: 231, figs. 413-414, 416, 433, 435 (radula); Numanami *et al.*, 1996: 211 (table), 213 (text), pl. 3, figs. 2, 5.

Material studied: 1 spm. (65.1 x 25.3 mm), PA24; 1 spm. (87.2 x 28.5 mm), PA25.

Remarks: DELL (1990) noted the variability of the strength of sculpture,similarly to *A. magnifica* (see above), concluding that individuals from greater depths may have finer secondary spirals.

Distribution: South Orkney and South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (DELL, 1990; this study) and Amery Ice-Shelf (NUMANAMI *ET AL.*, 1996); from 110 m (new record) to 1455 m (DELL, 1990).

Genus *Conorbela* Powell, 1951

Conorbela antarctica (Strebel, 1908) (Fig. 62)

Bela antarctica Strebel, 1908: 16, pl. 3, figs. 30a-b.
Conorbela antarctica: Powell, 1951: 170; Dell, 1990: 239, figs. 395, 415, 434 (radula); Hain, 1990: 70, pl. 7, figs. 9a-b, pl. 26, figs. 3-4 (radula).

Material studied: 2 spm. (15.7 x 8.3 - 23.0 x 10.8 mm), MB34; 1 spm. (17.2 x 9.1 mm), PA39.

Distribution: South Sandwich Islands (POWELL, 1951), Weddell Sea (STREBEL, 1908; HAIN, 1990), South Georgia Island (CARCELLES, 1953), South Shetland Islands (POWELL, 1951; DELL, 1990), Western Antarctic Peninsula, Bellingshausen Sea (new records) and Ross Sea (DELL, 1990); from 18 m (CARCELLES, 1953) to 1437 m (DELL, 1990).

Genus *Leucosyrinx* Dall, 1889

Leucosyrinx paratenoceras Powell, 1951 (Fig. 63)

Leucosyrinx paratenoceras Powell, 1951: 168, pl. 9, fig. 54; Castellanos and Landoni, 1993b: 6, pl. 3, fig. 21.

Material studied: 1 spm. (31.5 x 10.3 mm), MB4; 1 spm. (38.6 x 11.9 mm), MB36; 2 spm. (37.9 x 11.1 - 42.9 x 12.8 mm), MB37.

Remarks: Two similar species were described together for Falkland/Malvinas Islands in the same work (POWELL 1951): *L. paragenota* and *L. falklandica*; the first can be differentiated from *L. paratenoceras* mainly by its D/H ratio (0.35 in holotype of *L. paragenota vs.* 0.30 of *L. paratenoceras*) and having axial cords; the second is distinguished mainly by having stronger axial sculpture.

Distribution: Cited for the South Orkney Islands (CASTELLANOS AND LANDONI, 1993b), South Shetland Islands and Western Antarctic Peninsula (POWELL, 1951), Bellingshausen Sea and off Thurston Island (new records); from 200 to 810 m (POWELL, 1951).

Genus *Typhlodaphne* Powell, 1951

Typhlodaphne innocentia Dell, 1990 (Fig. 64)

Typhlodaphne innocentia Dell, 1990: 240, figs. 394, 406.

Material studied: 1 spm. (6.0 x 3.1 mm), PI5; 11 spm. (4.2 x 2.2 - 10.4 x 5.1 mm), PI8.

Remarks: DELL (1990) described this species based upon individuals of about 4 mm, but the characteristics of our specimens agree with Dell's description. *T. nipri* Numanami, 1996, from East Antarctica is similar because its author defined it as an allied species, but without axial sculpture. *T. corpulenta* (Watson, 1881), from Kerguelen Island, differs in having a thicker shell.

Distribution: Cited for the Weddell Sea (GRIFFITHS *ET AL.*, 2003); Peter I Island (new record) and Ross Sea (DELL, 1990); from 90 m (new record) to 549 m (DELL, 1990).

Genus *Typhlomangelia* Sars, 1878

Typhlomangelia principalis Thiele, 1912 (Fig. 65)

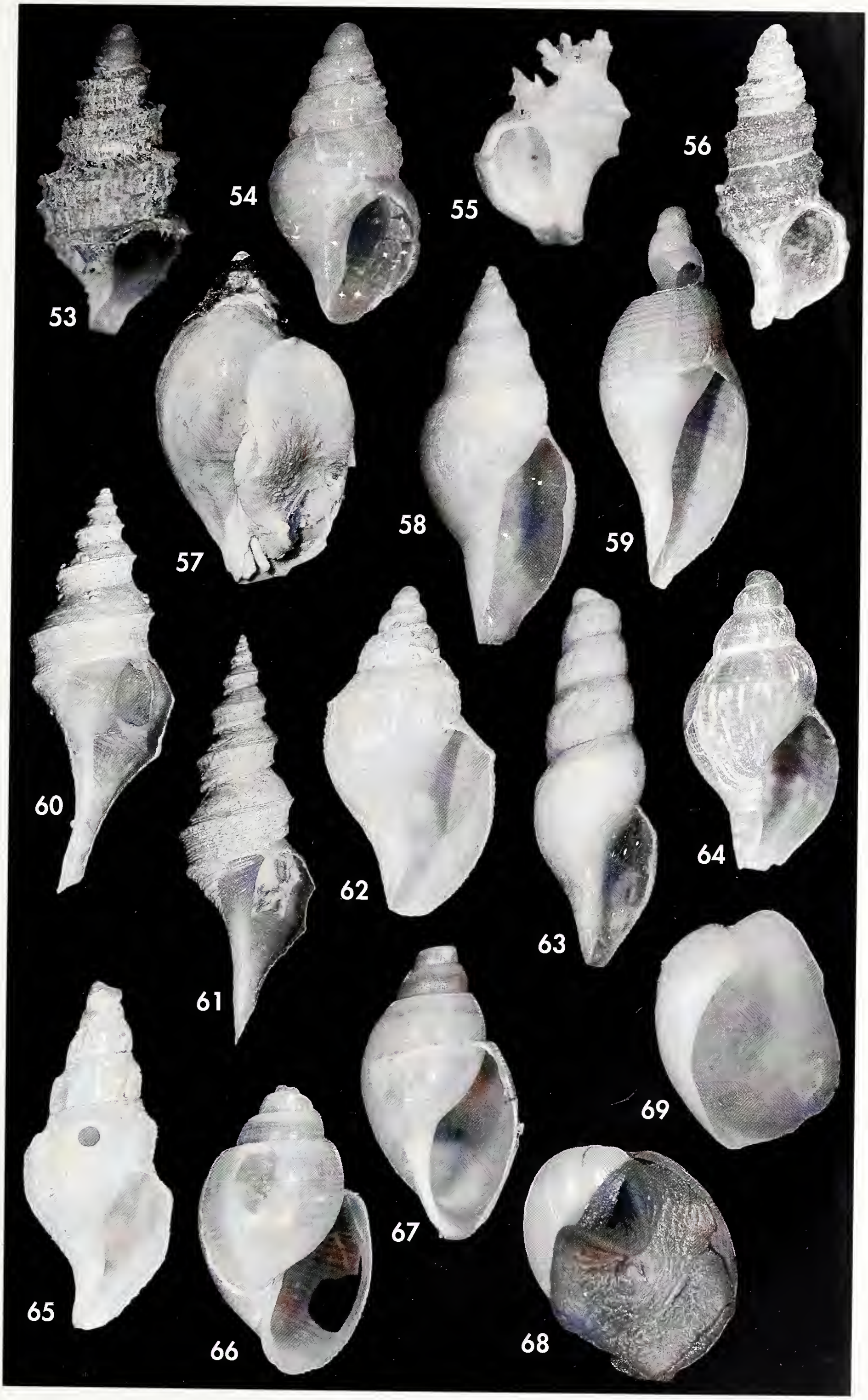
Typhlomangelia? principalis Thiele, 1912: 215, pl. 14, figs. 6-7; Egorova, 1982: 50, figs. 64 (radula), 209-210.

Material studied: 3 spm. and 1 sh. (9.2 x 4.1 - 17.5 x 7.9 mm), MB35; 1 spm. (19.2 x 7.0 mm), MB37; 1 sh. (16.8 x 7.9 mm), MB38.

Remarks: Although some specimens are a little eroded, the shell characteristics, such as flattened spiral cords crossing the axial ridges and marked growth striae, allowed us to assign it to Thiele's species, which has been little cited.

Distribution: Cited for the Weddell Sea (GRIFFITHS *ET AL.*, 2003); Bellingshausen Sea (new record) and Davis Sea (THIELE, 1912; EGOROVA, 1982) from 310 m (EGOROVA, 1982) to 1117 m (new record).

(Right page) Figure 53. *Prosipho pellitus*, 4.1 x 2.0 mm, PI8. Figure 54. *Prosipho pusillus*, 5.0 x 2.5 mm, PI8. Figure 55. *Prosipho reversus*, scale bar = 2.0 mm, PA39. Figure 56. *Prosipho turritus*, 5.6 x 2.4 mm, PA39. Figure 57. *Harpovoluta charcoti*, 54.8 x 32.0 mm, PA22. Figure 58. *Belaturricula ergata*, 18.0 x 7.9 mm, MB1. Figure 59. *Belaturricula gaini*, 20.0 x 8.1 mm, PA23. Figure 60. *Aforia magnifica*, 47.9 x 17.5 mm, PA21. Figure 61. *Aforia multispiralis*, 87.2 x 28.5 mm, PA25. Figure 62. *Conorbela antarctica*, 23.0 x 10.8 mm, MB34. Figure 63. *Leucosyrinx paratenoceras*, 31.5 x 10.3 mm, MB4. Figure 64. *Typhlodaphne innocentia*, 6.0 x 3.1 mm, PI5. Figure 65. *Typhlomangelia principalis*, 17.5 x 7.9 mm, MB35. Figure 66. *Acteon antarcticus*, 6.1 x 3.7 mm, MB3. Figure 67. *Neactaeonina edentula*, 6.7 x 3.5 mm, PI5. Figure 68. *Newnesia antarctica*, 18.0 x 15.0 mm, PA39. Figure 69. *Philine alata*, 9.2 x 7.3 mm, DEC.
(Página derecha) Figuras 53-69. Ver los nombres científicos en el rótulo en inglés.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Superorder Heterobranchia Gray, 1840
Order Opisthobranchia Milne-Edwards, 1848
Family Acteonidae d'Orbigny, 1842
Genus *Acteon* Montfort, 1810

Acteon antarcticus Thiele, 1912 (Fig. 66)

Actaeon antarcticus Thiele, 1912: 219, pl. 14, fig. 17.
Acteon antarcticus: Powell, 1951: 175; 1958: 205; Dell, 1990: 247, fig. 444.

Material studied: 1 spm. (6.1 x 3.7 mm), MB3.

Remarks: Several species of the former genus *Acteon* were described from Sub-Antarctic waters, although a lot of them have been situated in other genera in later works (e.g. *Toledonia vagabunda* (Mabille, 1885)). Among valid recent species, the Magellanic *A. biplicatus* (Strebel, 1908) and *A. elongatus* Castellanos, Rolán and Bartolotta, 1987 are separated by being more elongate forms.

Distribution: South Sandwich (Dell, 1990) and South Shetland Islands (Powell, 1951), off Thurston Island (new record), Ross Sea (Dell, 1990), Davis Sea (Thiele, 1912) and Enderby Land (Powell, 1958); from 101 m (Dell, 1990) to 1431 m (new record).

Genus *Neactaeonina* Thiele, 1912

Neactaeonina edentula (Watson, 1883) (Fig. 67)

Actaeon edentulus Watson, 1883: 284; 1886: 632, pl. 47, fig. 6.
Neactaeonina edentula: Thiele, 1912: 219; Powell, 1951: 176; Powell, 1957: 136; Dell, 1990: 248, figs. 439-440; Castellanos, Landoni and Dadon, 1993: 9, pl. 1, fig. 10.

Material studied: 6 spm. (6.3 x 3.3 - 9.0 x 5.0 mm), PI5; 1 spm. (18.0 x 9.5 mm), MB34; 1 spm. (5.3 x 3.1 mm), LOW.

Remarks: The individuals can be distinguished from *N. cingulata* (Strebel, 1908) by having spiral furrows which are shallower, irregular and and less numerous. However, Dell (1990) remarked on the uncertain relationship with *N. fragilis* (Thiele, 1912), because the original description of *N. fragilis* was made from a single damaged small specimen, and does not include a good description and figure of this. The record in Powell (1951) from South Shetland and South Georgia Islands may correspond to *N. cingulata*, according to Powell (1960).

Distribution: South Georgia (Powell, 1951), South Orkney (Carcelles, 1953) and South Shetland Islands (Powell, 1951; Dell, 1990; this study), Bellingshausen Sea and Peter I Island (new records), Ross Sea (Dell, 1990) and Kerguelen Islands (Watson, 1886; Powell, 1957; Dell, 1990); from 5 to 1116 m (Dell, 1990).

Family Diaphanidae Odhner, 1914
Genus *Newnesia* Smith, 1902

Newnesia antarctica Smith, 1902 (Fig. 68)

Newnesia antarctica Smith, 1902: 208, pl. 25, figs. 1-6; Thiele, 1912: 218; Hedley, 1916: 64; Odhner, 1926: 7, figs. 4-8; Dell, 1990: 254, fig. 482; Hain, 1990: 75, pl. 9, figs. 1a-i, pl. 28, fig. 1 (radula); Zelaya, 2005: 130, fig. 64.

Anderssonia sphinx Strebel, 1908: 12, pl. 2, figs. 21a-g.

Material studied: 4 spm. (7.3 x 5.8 - 18.0 x 15.0 mm), PA39.

Remarks: ODHNER (1926) synonymized this with Strebel's species *N. sphinx*.

Distribution: South Georgia (ZELAYA, 2005) and South Orkney Islands (CARCELLES, 1953), Weddell Sea (HAIN, 1990) and Eastern Antarctic Peninsula (STREBEL, 1908), Western Antarctic Peninsula (new record), Ross Sea (DELL, 1990), Cape Adare (SMITH, 1902) Terre Adélie and Shackleton Ice Shelf (HEDLEY, 1916), and Davis Sea (DELL, 1990); from 16 m (CARCELLES, 1953) to 655 m (DELL, 1990).

Family PHILINIDAE Gray, 1850
Genus *Philine* Ascanius, 1772

Philine alata Thiele, 1912 (Fig. 69)

Philine alata Thiele, 1912: 220, pl. 14, figs. 19-20; Powell, 1951: 177; Powell, 1958: 207; Vicente and Arnaud, 1974: 534, figs. 1a-d; Hain, 1990: 76, pl. 9, figs. 2a-l, pl. 28, fig. 2 (radula); Castellanos *et al.*, 1993: 16, pl. 2, fig. 15.

Material studied: 9 spm. (15.7 x 8.4 - 35.5 x 17.8 mm), PI5; 7 spm. (19.0 x 7.9 - 24.9 x 12.6 mm), PI6; 2 spm. (13.0 x 8.0 mm - broken), PA39; 70 spm. (4.0 x 3.0 - 12.5 x 8.6 mm), DEC.

Remarks: Some morphological differences in shell were observed between BENTART individuals and other Antarctic species. The outer lip is much higher than the spire, contrary to *P. antarctica* Smith, 1902; the shape is rhomboidal contrary to *P. apertissima* Smith, 1902 which is rounded, the spiral sculpture is lacking whereas it is present in *P. falklandica* Powell, 1951 and the hump present in *P. gibba* Strebel, 1908. DELL (1990) believes that a detailed revision of the genus is needed.

Distribution: Weddell Sea (HAIN, 1990), Scotia Sea, South Sandwich and South Orkney Islands (POWELL, 1951), South Shetland Islands and Western Antarctic Peninsula (POWELL, 1951; this study), Peter I Island (new record), Terre Adélie (VICENTE AND ARNAUD, 1974), Davis Sea (THIELE, 1912) and Enderby Land (POWELL, 1958); from 4 m (VICENTE AND ARNAUD, 1974) to 640 m (HAIN, 1990).

Class BIVALVIA Linnaeus, 1758
Subclass PROTOBRANCHIA Pelseneer, 1889
Order NUCULIDA Dall, 1889
Family NUCULIDAE Gray, 1824
Genus *Nucula* Lamarck, 1799

Nucula austrobenthalis Dell, 1990 (Fig. 70)

Nucula austrobenthalis Dell, 1990: 6, figs. 1, 3.

Material studied: 4 spm. (7.4 x 5.9 - 13.6 x 10.0 mm), MB29.

Remarks: In spite of there being few records of this species it is clearly separable as an elongate species from deeper-water, without similar species in Antarctic waters. The other deeper-water species of this genus, *N. notobenthalis* Thiele, 1912 from the Davis Sea at 2725 m depth, is more rounded and has a shorter anterior end.

Distribution: Drake Passage (57-62° S, 68-75° W) (DELL, 1990), Bellingshausen (DELL, 1990; this study), Amundsen and Ross Seas (DELL, 1990); from 3304 m (new record) to 4209 m (DELL, 1990).

Family NUCULANIDAE H. and A. Adams, 1858
Genus *Propeleda* Iredale, 1924

Propeleda longicaudata (Thiele, 1912) (Fig. 71)

Leda longicaudata Thiele, 1912: 229, pl. 17, fig. 22.
Poroleda longicaudata: Hedley, 1916: 18; Soot-Ryen, 1951: 5.
Propeleda longicaudata: Powell, 1951: 77; Powell, 1958: 171; Dell, 1964: 146; Egorova, 1982: 56: figs. 238-241; Dell, 1990: 15, figs. 51-52; Hain, 1990: 80, pl. 11, figs. 4a-b; Linse, 1997: 46.

Material studied: 1 spm. (16.3 x 6.1 mm), MB13; 1 spm. (15.0 x 6.0 mm), PA21; 1 spm. (9.0 x 3.5 mm), MB33; 3 spm. (2.0 x 1.1 - 3.0 x 1.8 mm), PA41.

Distribution: Circumantarctic. Weddell Sea (HAIN, 1990), cited for the South Sandwich Islands (LINSE, 1997), South Georgia, South Orkney and South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (DELL, 1990; this study), Bellingshausen Sea off Adelaide Island (POWELL, 1951; this study), Beagle Channel (LINSE, 1997), Antipodes Islands (50° S, 179° E) and Ross Sea (DELL, 1990), Terre Adélie (HEDLEY, 1916), Wilkes Land (POWELL, 1958), Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982) and from Amery Ice Shelf to Mac Robertson Land (POWELL, 1958); from 43 to 2100 m (DELL, 1990).

Family YOLDIIDAE Habe, 1977
Genus *Yoldia* Möller, 1842

Yoldia eightsi (Couthouy in Jay, 1839) (Fig. 72)

Nucula eightsi Couthouy in Jay, 1839: 113, pl. 1, figs. 12-13.
Yoldia eightsi: Melvill and Standen, 1907: 143; Hedley, 1911: 3; Dell, 1964: 147, pl. 2, fig. 11; Nicol, 1966: 11, pl. 1, figs. 6-8; Rabarts and Whybrow, 1979: 177, figs. 3-5, 8-10, 14a-b, 15a-b; Dell, 1990: 10, figs. 2, 5; Troncoso *et al.*, 2001: 106, fig. 33.
Yoldia subaequilateralis Smith, 1875: 73; 1879: 187, pl. 9, fig. 18; 1885: 243; 1902: 211. Soot-Ryen, 1951: 6; Powell, 1957: 114.
Yoldia kerguelensis Thiele and Jaeckel, 1931: 207, pl. 3 (8), fig. 65.
Yoldia woodwardi Hanley: Pelseneer, 1903: 10; Lamy, 1906b; 19; 1911a: 29; Soot-Ryen, 1951: 7, figs. 1-6 (no Hanley, 1860).

Material studied: 65 spm. (18.0 x 11.9 - 47.8 x 27.1 mm), PA22; 20 spm. (26.8 x 16.9 - 44.1 x 26.8 mm), PA23; 67 spm. (5.1 x 3.4 - 18.5 x 11.3 mm), DEC.

Remarks: SOOT-RYEN (1951) considered the Magellanic species *Y. woodwardi* Hanley, 1860 as a junior synonym and, since his work, several authors have followed him. But RABARTS AND WHYBROW (1979) revised this genus synonymizing *Y. subaequilateralis* Smith, 1875 and *Y. kerguelensis* Thiele and Jaeckel, 1931 and reporting the misidentification of some specimens named *Y. woodwardi*, by PELSENEER (1903), LAMY (1906b, 1911a) and SOOT-RYEN (1951),concluding that two species are valid for the Southern Ocean and neighboring areas: *Y. eightsi* and *Y. woodwardi*, the latter restricted to the Falkland/Malvinas Islands and South Atlantic Ocean.

Distribution: Cited for the Weddell Sea (GRIFFITHS *ET AL*., 2003), South Sandwich, South Georgia (DELL, 1990) and South Orkney Islands (MELVILL AND STANDEN, 1907; DELL, 1990), Eastern Antarctic Peninsula (DELL, 1990), South Shetland Islands (JAY, 1839; LAMY, 1911a; DELL, 1990; this study), Western Antarctic Peninsula (LAMY, 1911a; DELL, 1990; this study) and Peter I Island (SOOT-RYEN, 1951), also in Falkland/Malvinas, Staten Island, Tierra del Fuego Island (DELL, 1990) and Beagle Channel (PELSENEER, 1903), Ross Sea (SMITH, 1902; HEDLEY, 1911; DELL, 1990), Kerguelen Islands (SMITH, 1879; SMITH, 1885; THIELE AND JAECKEL, 1931; POWELL, 1957, TRONCOSO *ET AL*., 2001) and *ca*. 10° E (GRIFFITHS *ET AL*., 2003); from 1 m (MELVILL AND STANDEN, 1907) to 824 m (DELL, 1990).

Genus *Yoldiella* Verrill and Bush, 1897

Yoldiella antarctica (Thiele, 1912) (Figs. 73-74)

Leda antarctica Thiele, 1912: 229, pl. 17, figs. 21-21a.
Yoldiella antarctica: Soot-Ryen, 1951: 5; Powell, 1958: 171; Dell, 1964: 145; Arnaud, 1973: 555; Egorova, 1982: 55, figs. 230-231; Dell, 1990: 12, figs.17-18.

Material studied: 1 spm. (2.6 x 1.7 mm), PI7; 1 spm. (broken), MB14; 2 spm. (2.1 x 1.4 - 2.3 x 1.7 mm), PI27; 1 spm. (2.2 x 1.6 mm), MB30.

Remarks: The main characteristics that mark the difference from other Antarctic species are its very thin shell, a very small hinge with six anterior and seven posterior teeth, small and obliquely oriented, and a more elongated form. In this sense, DELL (1990) provides height/length ratios for related Antarctic species that allow the arranging of the species from more elongated to more rounded shape: *Yoldiella antarctica* (0.66 ± 0.01, n=6), *Y. profundorum* (Melvill and Standen, 1912) (0.69 ± 0.04, n=6), *Y. ecaudata* (Pelseneer, 1903) (0.74 ± 0.05, n=6) and *Y. valettei* (Lamy, 1906) (0.75 ± 0.05, n=10).

Distribution: South Sandwich and South Orkney Islands, Eastern Antarctic Peninsula and South Shetland Islands (DELL, 1990), Bellingshausen Sea and Peter I Island (new records), Ross Sea (DELL, 1990), Terre Adélie (GRIFFITHS *ET AL*., 2003), Davis Sea (THIELE, 1912; EGOROVA, 1982), Enderby Land (POWELL, 1958) and Bouvet Island (LINSE, 2006); from 193 m (POWELL, 1958) to 1873 m (new record).

Yoldiella ecaudata (Pelseneer, 1903) (Figs. 75-76)

Leda ecaudata Pelseneer, 1903: 22, pl. 6, figs. 77-78; Thiele, 1912: 229, pl. 17, figs. 20-20a.
Yoldiella ecaudata: Soot-Ryen, 1951: 5; Dell, 1964: 145; Egorova, 1982: 55, figs. 234-237; Dell, 1990: 12: 15-16.

Material studied: 1 spm. (2.8 x 1.9 mm), MB3; 14 spm. (1.2 x 1.0 - 2.3 x 1.8 mm), MB36; 7 spm. (1.1 x 0.8 - 2.3 x 1.8 mm), PA41.

Remarks: A hinge with large teeth , a marked postero-ventral rostrum and rounded shape (see remarck of *Y. antartica*) differentiate this species from the others.

Distribution: Western Antarctic Peninsula (DELL, 1990; this study), Bellingshausen Sea to off Thurston Island (PELSENEER, 1903; this study), Ross Sea, Balleny Islands (DELL, 1990) and Davis Sea (THIELE, 1912; EGOROVA, 1982); from 265 to 2525 m (DELL, 1990).

Yoldiella oblonga (Pelseneer, 1903) (Figs. 77-78)

Leda oblonga Pelseneer, 1903: 23, pl. 6, figs. 79-80; Hedley, 1916: 17; Soot-Ryen, 1951: 6.
Yoldiella oblonga: Egorova, 1982: 56, figs. 232-233; Hain, 1990: 79, pl. 11, figs. 1a-b.

Material studied: 1 sh. (broken), MB9; 1 spm. (5.3 x 3.9 mm), MB14; 1 spm. (2.8 x 1.9 mm), MB36.

Remarks: CARCELLES (1953) was the first author to include this species as *Yoldiella*. Due to its *Tindaria*-like form there are no similar species in Antarctic waters.

Distribution: Weddell Sea (HAIN, 1990), Bellingshausen Sea (PELSENEER, 1903; this study), cited for the Ross Sea (GRIFFITHS *ET AL*., 2003), Shackleton Ice Shelf (HEDLEY, 1916) and Davis Sea (EGOROVA, 1982); from 459 to 2800 m (PELSENEER, 1903).

Yoldiella profundorum (Melvill and Standen, 1912) (Figs. 79-80)

Yoldia profundorum Melvill and Standen, 1912: 359, figs. 18-18b.
Yoldiella profundorum: Soot-Ryen, 1951: 6; Dell, 1990: 14, figs. 21-22; Branch *et al*., 1991: 53 (key).

Material studied: 3 spm. (2.9 x 2.1 - 3.8 x 2.8 mm), PA22; 1 spm. (2.0 x 1.4 mm), MB26; 86 spm. (1.7 x 1.0 - 3.2 x 2.2 mm), PI28; 1 spm. (3.3 x 2.2 mm), MB30; 33 spm. (1.0 x 0.6 - 2.1 x 1.3 mm), MB33; 2 spm. (1.5 x 0.9 - 1.5 x 0.9 mm), MB34; 1 spm. (2.1 x 1.6 mm), PA39; 16 spm. (1.0 x 0.6 - 2.1 x 1.4 mm), PA41; 14 spm. (1.1 x 0.8 - 2.5 x 1.8 mm), PA42; 4 spm. (1.2 x 0.9 - 1.9 x 1.1 mm), PA43.

Remarks: A somewhat elongated hinge with seven anterior and six posterior, medium to large and weakly oblique teeth, mark the difference from the similar species *Y. ecaudata* (with nine anterior and seven posterior strong teeth) and *Y. antarctica* (six anterior and seven posterior small teeth).

Distribution: Weddell Sea (MELVILL AND STANDEN, 1912), Drake Passage (*ca*. 55-62° S, 61° W) (DELL, 1990), Western Antarctic Peninsula, Bellingshausen Sea to off Thurston Island, and Peter I Island (new records), Amundsen Sea (*ca*. 70° S, 99° W) (DELL, 1990), Marion and Prince Edward Islands (BRANCH *ET AL*., 1991); from 157 m (new record) to 4758 m (DELL, 1990).

Yoldiella sabrina (Hedley, 1916) (Figs. 81-82)

Malletia sabrina Hedley, 1916: 18, pl. 1, figs. 3-4; Soot-Ryen, 1951: 9; Powell, 1958: 172; Dell, 1964: 149; Nicol, 1966: 17, pl. 1, figs. 3, 5; Egorova, 1982: 54, figs. 226-228.
Yoldiella sabrina: Dell, 1972: 24, figs. 8-9; 1990: 14, fig. 14; Hain, 1990: 79, pl. 11, figs. 2a-b.

Material studied: 3 spm. (5.8 x 3.9 - 5.9 x 3.9 mm), MB30; 5 spm. (4.2 x 2.7 - 6.9 x 4.2 mm), MB31; 1 spm. (6.0 x 3.9 mm), MB32; 1 spm. (6.1 x 4.1 mm), MB35; 2 spm. (1.9 x 1.2 - 4.2 x 2.8 mm), MB36.

Remarks: Similar in external morphology to species of the genus *Malletia* Desmoulins, 1832. DELL (1972) situated this species as *Yoldiella* based on its internal ligament, and he compared it with the Southern Chile species *Y. chilenica* (Dall, 1908), very similar in shell proportions and secondarily in the hinge.

Distribution: Weddell Sea (HAIN, 1990), South Shetland Islands (DELL, 1990), Bellingshausen Sea (new record), Ross Sea (DELL, 1990), Terre Adélie and Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (EGOROVA, 1982) and Mac Robertson Land (POWELL, 1958); from 12 m (HAIN, 1990) to 1847 m (new record).

Subclass PTERIOMORPHIA Beurlen, 1944
Order ARCIDA Stoliczka, 1871
Family ARCIDAE Lamarck, 1809
Genus *Bathyarca* Kobelt, 1891

Bathyarca sinuata Pelseneer, 1903 (Fig. 83)

Bathyarca sinuata Pelseneer, 1903: 23, pl. 6, figs. 81-82; Lamy, 1911a: 27; Soot-Ryen, 1951: 9; Dell, 1990: 17, figs. 4, 10-11

Material studied: 6 spm. (6.2 x 5.0 - 8.6 x 6.9 mm), MB3; 4 spm. (6.1 x 4.3 - 9.0 x 6.2 mm), MB11; 1 spm. (6.9 x 4.7 mm), MB13; 11 spm. (4.8 x 3.6 - 8.8 x 7.0 mm), MB17; 6 spm. (6.0 x 4.5 - 8.0 x 6.0 mm), MB30; 5 spm. (6.0 x 4.7 - 8.8 x 6.8 mm), MB31; 4 spm. (4.8 x 3.2 - 8.1 x 6.7 mm), MB35; 4 spm. (7.1 x 5.1 - 8.1 x 6.2 mm), MB38.

Remarks: The other species of the genus cited for Antarctica is *B. strebeli* (Melvill and Standen, 1907) from the Weddell Sea, which is very different in shell shape, presenting an oval form.

Distribution: Cape Horn (DELL, 1990), Bellingshausen Sea (PELSENEER, 1903; LAMY, 1911a; this study) to off Thurston Island (new record) and Ross Sea (DELL, 1990); from 400 m (PELSENEER, 1903) to 2044 m (new record).

Family LIMOPSIDAE Dall, 1895
Genus *Limopsis* Sassi, 1827

Limopsis knudseni Dell, 1990 (Fig. 84)

Limopsis knudseni Dell, 1990: 23, figs. 30-31.

Material studied: 1 spm. (7.4 x 7.6 mm), MB29.

Remarks: DELL (1990) described this species after examination of many individuals series of several Antarctic species, concluding that the posteroventral elongated form of some individuals, together with the development of a byssus in most of them, are definitive and particular characteristics of the new species. Our specimen have the umbos larger than the figure of the holotype, which may be eroded.

Distribution: South Atlantic Ocean off South Georgia Island (*ca.* 50° S, 43° W), Cape Horn, Drake Passage (*ca.* 60° S, 69° W) (DELL, 1990) and Bellingshausen Sea (DELL, 1990; this study); from 1043 to 3693 m (DELL, 1990).

Limopsis lilliei Smith, 1915 (Fig. 85)

Limopsis lilliei Smith, 1915: 76, pl. 1, fig. 18; Powell, 1958: 172; Dell, 1964: 158, pl. 3, figs. 1-2; Nicol, 1966: 18, pl. 2, figs. 3, 6; Arnaud, 1973: 555; Egorova, 1982: 57, figs. 248-249; Dell, 1990: 20, figs. 32-33; Hain, 1990: 82, pl. 11, figs. 7a-b; Branch *et al.*, 1991: 54.

Material studied: 1 spm. (4.4 x 4.1 mm), PA21; 1 spm. (6.3 x 4.9 mm), PA25; 2 spm. (17.2 x 15.2 - 21.5 x 17.0 mm), LOW.

Remarks: According to DELL (1990) it presents an affinity in shape with *L. hirtella* Mabille and Rochebrune, 1889, but that species apparently is confined

to the Magellanic Region (DELL, 1990). Also, *L. scotiana* Dell, 1964 is close as well, but its distribution is in the Scotia Arc Islands (DELL, 1990).

Distribution: Weddell Sea (HAIN, 1990), South Sandwich, South Georgia and South Orkney Islands (DELL, 1990), South Shetland Islands and Western Antarctic Peninsula (DELL, 1990; this study), Antipodes Islands (*ca.* 179° E) (DELL, 1990), Ross Sea (SMITH, 1915; DELL, 1990), Terre Adélie (GRIFFITHS *ET AL.*, 2003), Davis Sea (EGOROVA, 1982), Enderby Land (POWELL, 1958), Marion and Prince Edward Islands (BRANCH *ET AL.*, 1991) and Bouvet Island (LINSE, 2006); from 20 m (DELL, 1990; HAIN, 1990) to 2100 m (DELL, 1990).

Limopsis longipilosa Pelseneer, 1903 (Fig. 86)

Limopsis longipilosa Pelseneer, 1903: 25, pl. 7, figs. 89-90; Melvill and Standen, 1912: 360: Soot-Ryen, 1951: 9, figs. 7-8; Dell, 1964: 155; Egorova, 1982: 58, figs. 250-251.

Material studied: 1 spm. (2.2 x 2.5 mm), MB4; 1 spm. (3.3 x 3.5 mm), MB14; 1 spm. (2.3 x 2.7 mm), MB33; 7 spm. (1.2 x 1.3 - 3.8 x 3.9 mm), MB36; 11 spm. (2.3 x 2.3 - 3.3 x 3.3 mm), MB37.

Remarks: *L. mabilliana* Dall, 1908 is similar in shape and periostracum, though it differs in having the dorsal border straighter with angulose anterior and posterior ends. DELL (1990 pp. 20, 25-26) mentioned that *L. longipilosa* may correspond to juvenile specimens of *L. marionensis* Smith, 1885 or of *L. tenella tenella* Jeffreys, 1879, but *L. tenella tenella* inhabits deeper waters (> 2400 m depth). Due to the confusion that exists in this group of related especies, we maintained *L. longipilosa* as a valid species, though it is necessary to make a comparative study of the hinge and juvenile stages of several related species (e.g. MALCHUS AND WARÉN, 2005).

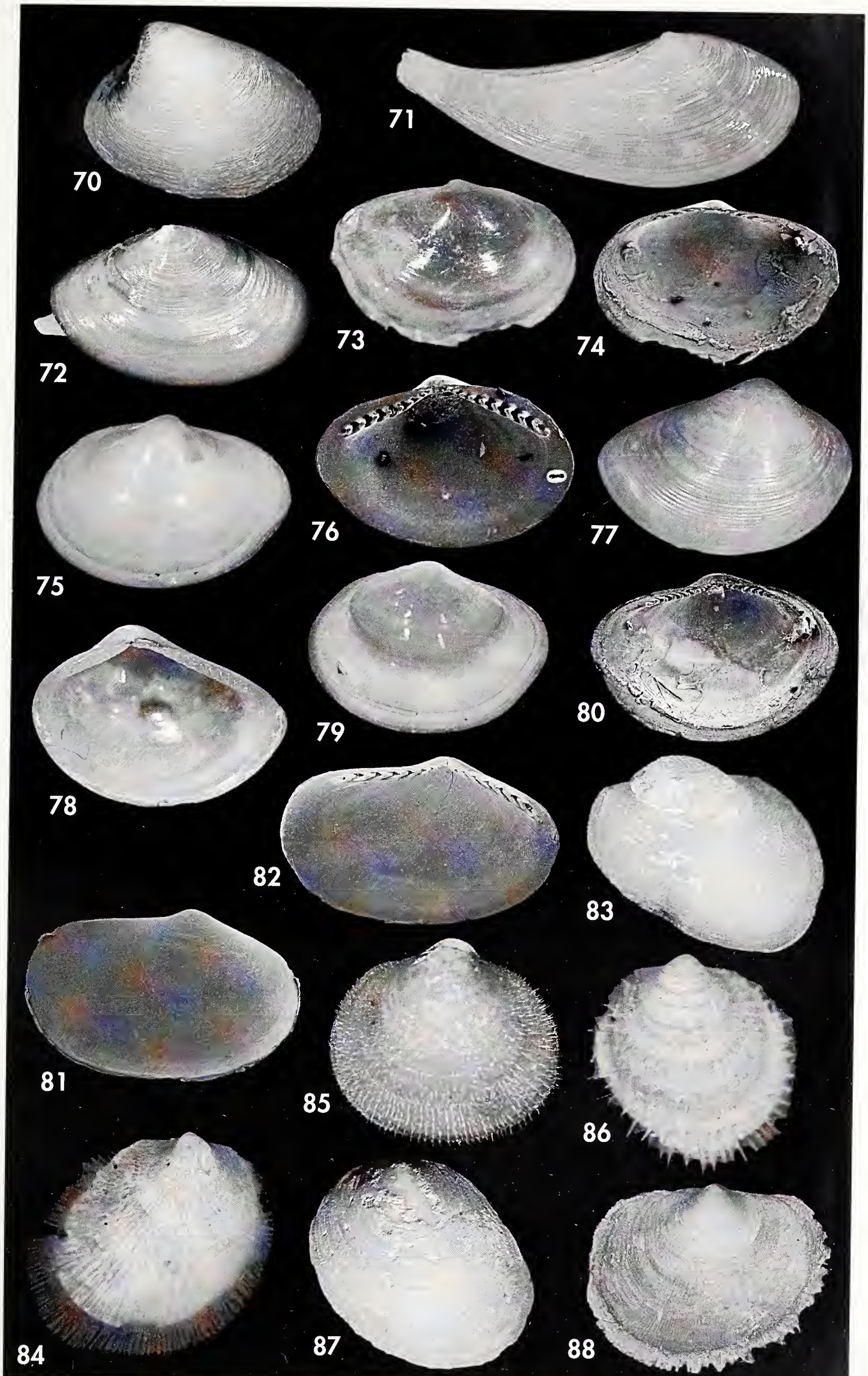
Distribution: Weddell Sea (MELVILL AND STANDEN, 1912), Western Antarctic Peninsula (SOOT-RYEN, 1951), Bellingshausen Sea (PELSENEER, 1903; this study) to off Thurston Island (new record) and Davis Sea (EGOROVA, 1982), but cited for the South Shetland Islands as well (CARCELLES, 1953). The bathymetry is from 90 m (EGOROVA, 1982) to 2579 m (MELVILL AND STANDEN, 1912).

Limopsis marionensis Smith, 1885 (Fig. 87)

Limopsis marionensis Smith, 1885: 254, pl.18, figs. 2-2b; 1915: 75; Dell, 1964: 152, pl. 3, figs. 6-14, pl. 4, figs. 1-2; Nicol, 1966: 22, pl. 2, figs. 1, 5; Egorova, 1982: 59, figs. 252-253; Okutani, 1986: 279 (table), pl. 2, fig. 12; Dell, 1990: 19, figs. 25-26; Hain, 1990: 82, pl. 12, figs. 1a-b; Branch *et al.*, 1991: 53 (key); Numanami *et al.*, 1996: 211 (table), 213 (text), pl. 4, fig. 10; Osorio and Reid, 2004: 80, fig. 3b.

Felicia jousseaumi Mabille and Rochebrune, 1889: 116, pl. 7, figs. 9a-b.

(Right page) Figure 70. *Nucula austrobenthalis*, 12.0 x 8.9 mm, MB29. Figure 71. *Propeleda longicaudata*, 16.3 x 6.1 mm, MB13. Figure 72. *Yoldia eightsi*, 24.0 x 15.1 mm, PA22. Figures 73, 74. *Yoldiella antarctica*, 2.6 x 1.7 mm, PI7. Figures 75-76. *Yoldiella ecaudata*, 2.8 x 1.9 mm, MB3. Figures 77, 78. *Yoldiella oblonga*, 5.3 x 3.9 mm, MB14. Figure 79. *Yoldiella profundorum*, 2.9 x 2.1 mm, PA22. Figure 80. *Yoldiella profundorum*, 3.8 x 2.8 mm, PA22. Figure 81. *Yoldiella sabrina*, 4.2 x 2.7 mm, MB31. Figure 82. *Yoldiella sabrina*, 4.3 x 2.8 mm, MB31. Figure 83. *Bathyarca sinuata*, 6.9 x 4.7 mm, MB13. Figure 84. *Limopsis knudseni*, 7.4 x 7.6 mm, MB29. Figure 85. *Limopsis lilliei*, 4.4 x 4.1 mm, PA21. Figure 86. *Limopsis longipilosa*, 2.2 x 2.5 mm, MB4. Figure 87. *Limopsis marionensis*, 25.5 x 24.6 mm, MB37. Figure 88. *Limopsis enderbyensis*, 15.0 x 12.0 mm, LOW.
(Página derecha) Figuras 70-88. Ver los nombres científicos en el rótulo en inglés.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Limopsis jousseaumei: Lamy, 1911a: 26; Thiele, 1912: 228 (text), pl. 17, fig. 14b; Powell, 1951: 78; Soot-Ryen, 1951: 9; Stuardo, 1962: 7, figs. 1-6.
Limopsis laeviuscula Pelseneer, 1903: 24, pl. 7, figs. 91-92.
Limopsis grandis Smith, 1907b: 5, pl. 3, figs. 7-7b; Thiele, 1912: 228, pl. 17, figs. 14a, 15; Smith, 1915: 76; Hedley, 1916: 19.
Limopsis jousseaumi grandis: Powell, 1958: 173; Egorova, 1982: 57, figs. 245-247.

Material studied: 7 spm. (25.5 x 24.3 - 39.5 x 42.2 mm), MB37.

Remarks: The Magellanic species *L. hirtella* Mabille and Rochebrune, 1889 has an affinity with this species, though it is more oval and equilateral. The numerous species that have been synonymized have been acceptedas such, because some authors have examined many individuals from several localities. According to Dell (1990) *L. hardingi* Melvill and Standen, 1914 from Falkland/Malvinas Islands is a junior synonym.

Distribution: Widespread Antarctic and Sub-Antarctic distribution. Has been cited from the Weddell Sea (Hain, 1990), South Sandwich Islands, South Orkney Islands, Falkland/Malvinas Islands and Burdwood Bank (Dell, 1990), Beagle Channel (Rochebrune and Mabille, 1889), Magellan Strait and Tierra del Fuego Island (Dell, 1990) and from several sites northward to South Pacific coast: South of Chiloé Islands (44° S) (Osorio and Reid, 2004), Seno de Reloncaví and Chiloé Islands (41-42° S) (Cárdenas, Aldea and Valdovinos, in press), 39° S off Valdivia (Dell, 1990), reaching off Algarrobo (33° S) in central Chile (Stuardo, 1962); also in South Shetland Islands (Dell, 1990) and Western Antarctic Peninsula (Lamy, 1911a; Dell, 1990), off Adelaide Island (Powell, 1951) and Bellingshausen Sea (Pelseneer, 1903; Dell, 1990; this study); Southwest Pacific Ocean (59° S, 160° W) (Dell, 1990), Ross Sea (Smith, 1907b; Smith, 1915; Dell, 1990), cited for the Scott and Balleny Islands (Griffiths *et al.*, 2003), Terre Adélie and Shackleton Ice Shelf (Hedley, 1916), Davis Sea (Thiele, 1912; Powell, 1958; Egorova, 1982), Amery Ice-Shelf (Powell, 1958; Numanami *et al.*, 1996), cited for the Heard and Kerguelen Islands (Dell, 1990), Mac Robertson Land to Enderby Land (Powell, 1958), Marion and Prince Edward Islands (Smith, 1885; Branch *et al.*, 1991) and 24° E (Okutani 1986); from 27 to 2804 m (Dell, 1990). Has not been cited for South Georgia Island, which is an anomaly in the Biogeography of the Southern Ocean (Dell, 1990).

Limopsis enderbyensis Powell, 1958 (Fig. 88)

Limopsis enderbyensis Powell, 1958: 172, pl. 1, fig. 4; Dell, 1964: 159; Hain, 1990: 82, pl. 11, figs. 6a-b.

Material studied: 1 spm. (15.0 x 12.0 mm), LOW.

Remarks: This species looks similar to the deeper-water species *L. tenella dalli* Lamy, 1912 from close to the Amundsen Sea (Dell, 1990), but that species is characterized by a more inequilateral shell.

Distribution: Only known in the Weddell Sea (Hain, 1990), South Shetland Islands (new record) and Enderby Land (Powell, 1958); from 115 m (new record) to 673 m (Hain, 1990).

Family Philobryidae Bernard, 1897
Genus *Adacnarca* Pelseneer, 1903

Adacnarca nitens Pelseneer, 1903 (Fig. 89)

Adacnarca nitens Pelseneer, 1903: 24, 41, pl. 7, figs. 83-88; Lamy, 1906b: 19; Smith, 1907b: 5, pl. 3, fig. 6-6c; Hedley, 1911: 3; Lamy, 1911a: 27; Thiele, 1912: 228; Smith, 1915: 76; Hedley, 1916: 22; Soot-Ryen, 1951: 13; Powell, 1958: 175; Dell, 1964: 172; Nicol, 1966: 31, pl. 4, figs. 9-10; Arnaud, 1973: 556; Egorova, 1982: 61, figs. 262-265; Dell, 1990: 31, figs. 38-39, 40, 43; Hain, 1990: 86, pl. 12, figs. 6a-b.

Material studied: 200 spm. (2.2 x 2.1 - 5.4 x 5.1 mm), PI5; 17 spm. (3.1 x 2.9 - 5.4 x 5.1 mm), PI8; 3 spm. (3.8 x 3.7 - 5.1 x 5.0 mm), PA20; 1 spm. (4.2 x 3.8 mm), PA21; 1 spm. (3.1 x 3.0 mm), PA22; 1 spm. (3.1 x 3.2 mm), MB36; 1 spm. (3.8 x 3.9 mm), MB38; 3 spm. (4.0 x 4.0 - 4.2 x 4.3 mm), PA39; 1 spm. (4.8 x 4.7 mm), LOW; 3 spm. (2,8 x 2,5 - 4.9 x 3.6 mm), DEC.

Remarks: *A. polarsterni* Egorova, 2003 seems to be an allied species, but it differs in being more elongated and not having a subcircular shape. *A. limopsoides* (Thiele, 1912) differs in having radial ribs and larger hinge teeth.

Distribution: Weddell Sea (HAIN, 1990), South Sandwich, South Georgia, South Orkney Islands and Eastern Antarctic Peninsula (DELL, 1990), South Shetland Islands (DELL, 1990; this study), Western Antarctic Peninsula (LAMY, 1911a; DELL, 1990; this study), Bellingshausen Sea (PELSENEER, 1903; this study) and Peter I Island (SOOT-RYEN, 1951; this study), Cape Horn (DELL, 1990), Ross Sea (SMITH, 1907b; HEDLEY, 1911; SMITH, 1915; DELL, 1990) to 163° E (SMITH, 1915), Commonwealth (HEDLEY, 1916) to Terre Adélie (POWELL, 1958), Wilkes Land (DELL, 1990), Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982), Amery Ice-Shelf (GRIFFITHS *ET AL.*, 2003), Mac Robertson to Enderby Land (POWELL, 1958), and Bouvet Island (LINSE, 2006); from 8 to 2350 m (DELL, 1990).

Genus *Lissarca* Smith, 1879

Lissarca notorcadensis Melvill and Standen, 1907 (Fig. 90)

Lissarca notorcadensis Melvill and Standen, 1907: 44, figs. 14-14a; Smith, 1915: 75, pl. 1, figs. 16-17; Hedley, 1916: 19; Soot-Ryen, 1951: 15; Powell, 1951: 78; Powell, 1958: 175; Dell, 1964: 173; Nicol, 1966: 36, pl. 4, figs. 2, 4, 6; Arnaud, 1973: 555; Egorova, 1982: 62, figs. 266-268; Okutani, 1986: 279 (table), pl. 2, figs. 13-14; Dell, 1990: 32, figs. 46, 58; Hain, 1990: 87, pl. 13, figs. 2a-b.
Arca gourdoni Lamy, 1910b: 393; 1911a: 28, pl. 1, figs. 21-22.
Lissarca gourdoni: Thiele, 1912: 228, pl. 18, figs. 3-3a.

Material studied: 1 spm. (7.0 x 6.6 mm), PA21; 36 spm. (2.9 x 2.8 - 6.1 x 6.2 mm), PA39; 49 spm. (1.6 x 1.5 - 4.3 x 4.4 mm), LOW; 2 spm. (4.5 x 3.2 - 4.5 x 3.2 mm), MAR.

Remarks: It is a variable species since COPE AND LINSE (2006) found considerable morphological differences between samples from the Scotia Arc, the Ross Sea and the Weddell Sea. The synonymy of *L. gourdoni* (Lamy, 1911) was proposed by SMITH (1915). Two other species of the genus, *L. miliaris* (Philippi, 1845) and *L. rubrofusca* (Smith, 1879) differ in having more inequilateral shells which are very similar, because DELL (1990) remarks that the distinction between both species has been difficult.

Distribution: Weddell Sea (HAIN, 1990), South Sandwich, South Georgia (DELL, 1990), South Orkney (MELVILL AND STANDEN, 1907; DELL, 1990), Falkland/Malvinas (POWELL, 1951) and South Shetland Islands (SOOT-RYEN, 1951; DELL, 1990; this study), Western Antarctic Peninsula (LAMY, 1911a; SOOT-RYEN, 1951; DELL, 1990; this study), Ross Sea (SMITH, 1915; DELL, 1990) to 163° E (SMITH, 1915), Commonwealth (HEDLEY, 1916) to Terre Adélie (HEDLEY, 1916; POWELL, 1958), Wilkes Land (DELL, 1990), Shackleton Ice Shelf

(HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982), Amery Ice-Shelf, Mac Robertson Land and Enderby Land (POWELL, 1958), probably in Kerguelen Islands (DELL, 1990), and 24° E (OKUTANI, 1986); from 0 to 1890 m (DELL, 1990).

Genus *Philobrya* Carpenter, 1872

Philobrya sublaevis Pelseneer, 1903 (Fig. 91)

Philobrya sublaevis Pelseneer, 1903: 25, pl. 7, figs. 93-94; Lamy, 1906b: 18, pl. 1, figs. 17-18; Lamy, 1911a: 25; Thiele, 1912: 227, pl. 17, fig. 11; Melvill and Standen, 1912: 361; Thiele and Jaeckel, 1931: 192; Dell, 1964: 163, pl. 4, fig. 7, fig. 2 (N° 3, 15-16); Nicol, 1966: 28, pl. 4, figs. 3, 5, 7; Arnaud, 1973: 555; Dell, 1990: 27, figs. 41, 50; Hain, 1990: 84, pl. 12, figs. 4a-d; Numanami *et al.*, 1996: 211 (table), pl. 4, fig. 1.
Philippiella sublaevis: Soot-Ryen, 1951: 12.
Hochstetteria sublaevis: Egorova, 1982: 60, figs. 257-259.
Philobrya limoides Smith, 1907b: 4, pl. 3, figs. 2-2b; Hedley, 1911: 3; Thiele, 1912: 268; Smith, 1915: 77; Thiele and Jaeckel, 1931: 191.
Philippiella limoides: Hedley, 1916: 20; Soot-Ryen, 1951: 10.
Hochstetteria limoides: Powell, 1958: 173.
Philippiella bagei Hedley, 1916: 20, pl. 1, figs. 5-7; Soot-Ryen, 1951: 10.
Hochstetteria bagei: Powell, 1958: 174.
Philippiella orbiculata Hedley, 1916: 21, pl. 1, figs. 12-13.
Philobrya antarctica Thiele and Jaeckel, 1931: 190 (*nom. nov.* for *P. limoides* Smith, 1907).

Material studied: 14 spm. (4.9 x 4.1 - 12.8 x 12.1 mm), PI5; 5 spm. (5.7 x 5.2 - 10.5 x 11.0 mm), PI8; 5 spm. (5.8 x 5.4 - 9.2 x 8.5 mm), PA20; 1 spm. (6.4 x 6.6 mm), PA21; 1 spm. (11.0 x 11.0 mm), PA22; 11 spm. (2.9 x 3.0 - 12.0 x 12.0 mm), PA39; 3 spm. (6.0 x 6.0 - 8.3 x 8.2 mm), LOW; 9 spm. (2.2 x 3.0 - 6.9 x 7.0 mm), DEC; 2 spm. (6.0 x 6.0 - 8.7 x 8.0 mm) MAR.

Remarks: It is a well known and reported species, whose synonymies are accepted (see DELL, 1990). The central position of the straight umbo marks the difference between this species and others cited from neighboring areas, all of them showing a certain degree of inequilaterality, e.g. *P. quadrata* (Pfeffer, 1886) and *P. ungulata* (Pfeffer, 1886). D-shape larvae were identified following EGOROVA (1982).

Distribution: Weddell Sea (HAIN, 1990), South Sandwich (DELL, 1990), South Georgia (SOOT-RYEN, 1951; DELL, 1990) and South Orkney Islands (DELL, 1990), Burdwood Bank (MELVILL AND STANDEN, 1912), Eastern Antarctic Peninsula (DELL, 1990), South Shetland Islands and Western Antarctic Peninsula (LAMY, 1911a; SOOT-RYEN, 1951; DELL, 1990; this study), Bellingshausen Sea (PELSENEER, 1903) and Peter I Island (SOOT-RYEN, 1951; this study), Ross Sea (SMITH, 1907b; HEDLEY, 1911; SMITH, 1915; DELL, 1990) to 163° E (SMITH, 1915), Commonwealth to Terre Adélie (HEDLEY, 1916), Wilkes Land (DELL, 1990), Davis Sea (THIELE, 1912; HEDLEY, 1916; EGOROVA, 1982; DELL, 1990), Amery Ice-Shelf (GRIFFITHS *ET AL.*, 2003), Mac Robertson to Enderby Land (POWELL, 1958), Syowa (NUMANAMI *ET AL.*, 1996), South of Africa in South Atlantic Ocean (34-35° S, 19-26° E) (THIELE AND JAECKEL, 1931), Bouvet Island (THIELE AND JAECKEL, 1931; LINSE, 2006) and *ca.* 10° E (GRIFFITHS *ET AL.*, 2003); from 1 m (DELL, 1990; HAIN, 1990) to 923 m (DELL, 1990).

Philobrya wandelensis Lamy, 1906 (Fig. 92)

Philobrya wandelensis Lamy, 1906a: 50; 1906b: 17, pl. 1, figs. 15-16; Melvill and Standen, 1907: 146; Lamy, 1911a: 24; Melvill and Standen, 1912: 361; Hedley, 1916: 19; Thiele, 1912: 268; Dell, 1964: 167; Arnaud, 1973: 556; Dell, 1990: 29, figs. 42, 47-49.

Hochstetteria wandelensis: Soot-Ryen, 1951: 11; Powell, 1958: 174.
Adacnarca wandelensis: Nicol, 1966: 33, pl. 3, figs. 4-5; Hain, 1990: 87, pl. 13, figs. 1a-b.

Material studied: 1 spm. (3.2 x 2.5 mm), PA20; 5 spm. (2.1 x 3.1 - 3.1 x 4.1 mm), DEC; 2 spm. (5.0 x 3.2 - 5.0 x 3.2 mm), MAR.

Remarks: Its strong inequilaterality marks the difference between this species and the other related species with a lesser degree of inequilaterality (*P. quadrata* (Pfeffer, 1886) and *P. ungulata* (Pfeffer, 1886)), though *P. crispa* Linse, 2002 from Tierra del Fuego Island, is a strongly inequilateral species, but differs in having periostracal spines, that *P. wandelensis* does not have.

Distribution: Weddell Sea (HAIN, 1990), South Sandwich, South Georgia (DELL, 1990) and South Orkney Islands (MELVILL AND STANDEN, 1907, 1912; DELL, 1990), Burdwood Bank and Falkland/Malvinas Islands (MELVILL AND STANDEN, 1912), Eastern Antarctic Peninsula (DELL, 1990), South Shetland Islands (DELL, 1990; this study), Western Antarctic Peninsula (LAMY, 1911a; DELL, 1990; this study), Ross Sea (DELL, 1990), Commonwealth (HEDLEY, 1916), Amery Ice-Shelf (GRIFFITHS *ET AL.*, 2003), Mac Robertson to Enderby Land (POWELL, 1958) and Bouvet Island (LINSE, 2006); from 5 m (HEDLEY, 1916) to 870 m (DELL, 1990).

Order MYTILIDA Férussac, 1822
Family MYTILIDAE Rafinesque, 1815
Genus *Dacrydium* Torell, 1859

Dacrydium albidum Pelseneer, 1903 (Fig. 93)

Dacrydium albidum Pelseneer, 1903: 26, pl. 8, fig. 100; Thiele, 1912: 226, pl. 17, fig. 10; Soot-Ryen, 1951: 20; Nicol, 1966: 25, pl. 3, figs. 2, 8; Egorova, 1982: 63, figs. 269-270; Dell, 1990: 33, figs. 55-57; Hain, 1990: 88, pl. 13, figs. 3a-b; Numanami *et al.*, 1996: 211 (table), pl. 4, fig. 2.
Dacrydium modioliforme Thiele, 1912: 226, pl. 17, fig. 9; Thiele and Jaeckel, 1931: 170; Soot-Ryen, 1951: 20; Powell, 1958: 175; Egorova, 1982: 64, figs. 271-272.

Material studied: 9 spm. (2.1 x 2.5 - 2.8 x 3.4 mm), MB30; 4 spm. (1.8 x 2.1 - 3.6 x 4.1 mm), MB34; 4 spm. (2.1 x 2.4 - 3.6 x 4.0 mm), MB38; 1 spm. (2.1 x 2.3 mm), PA41.

Remarks: NICOL (1966) and DELL (1990) considered that *D. molioliforme* Thiele, 1912, from the Davis Sea, may be a synonym.

Distribution: Weddell Sea (HAIN, 1990), South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (new record), Bellingshausen Sea (PELSENEER, 1903; DELL, 1990; this study), Ross Sea (DELL, 1990), Davis Sea (THIELE, 1912; EGOROVA, 1982), Amery Ice-Shelf (POWELL, 1958), Enderby Land (THIELE AND JAECKEL, 1931) and Syowa (NUMANAMI *ET AL.*, 1996); from 122 m (DELL, 1990) to 4636 m (THIELE AND JAECKEL, 1931). Also, GRIFFITHS *ET AL.* (2003) indicated this species in several sites off Africa in the South Atlantic Ocean.

Order LIMIDA Waller, 1978
Family LIMIDAE Rafinesque, 1815
Genus *Limatula* S. V. Wood, 1839

Limatula hodgsoni (Smith, 1907) (Fig. 94)

Lima hodgsoni Smith, 1907b: 6, pl. 3, figs. 8-8b; Hedley, 1911: 3; Thiele, 1912: 226; Smith, 1915: 77; Hedley, 1916: 24; Thiele and Jaeckel, 1931: 167.

Limatula hodgsoni: Soot-Ryen, 1951: 20; Powell, 1958: 177; Dell, 1964: 184; Nicol, 1966: 43, pl. 5, figs. 6-7; Arnaud, 1973: 556; Egorova, 1982: 66, figs. 285-287; Okutani, 1986: 279 (table), pl. 2, figs. 18-19; Dell, 1990: 53, fig. 95; Hain, 1990: 91, pl. 13, figs. 7a-f; Numanami *et al.*, 1996: 211 (table), 213 (text), pl. 4, fig. 3; Page and Linse, 2002: 819 (table, text); Linse and Page, 2003: 290, figs. 1e, 3 (prodissoconch); Allen, 2004: 2645.

Lima closei Hedley, 1916: 23, pl. 2, fig. 16.

Limatula closei: Soot-Ryen, 1951: 20; Dell, 1964: 184; Egorova, 1982: 65, fig. 288.

Material studied: 2 spm. (11.5 x 9.3 - 29.3 x 22.7 mm), PA20; 1 spm. (9.0 x 7.6 mm), MB30; 9 spm. (2.1 x 1.9 - 12.1 x 10.0 mm), MB31; 6 spm. (1.4 x 1.1 - 36.2 x 27.9 mm), PA39; 2 spm. (10.9 x 14.0 - 24.0 x 18.0 mm), LOW.

Remarks: PAGE AND LINSE (2002) situated it as sister species of *L. ovalis* (Thiele, 1912) and *L. pygmaea* (Philippi, 1845), utilizing molecular techniques; they also established that they have indirect development with lecitotrophic larvae (LINSE AND PAGE, 2003). This species differs from *L. ovalis* and *L. pygmaea* in having a more developed concentric sculpture with lamellae. DELL (1964) commented that *L. closei* (Hedley, 1916) is an allied species and DELL (1990) situated it as a junior synonym.

Distribution: Weddell Sea (HAIN, 1990), South Sandwich, South Georgia, South Orkney Islands, Eastern Antarctic Peninsula and Cape Horn (DELL, 1990), South Shetland Islands and Western Antarctic Peninsula (DELL, 1990; this study), Bellingshausen Sea (new record), Ross Sea (SMITH, 1907b; HEDLEY, 1911; SMITH, 1915; DELL, 1990) to 163° E (SMITH, 1915), Macquarie Island (Tomlin 1948 in POWELL, 1960), Commonwealth to Terre Adélie, and Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982; DELL, 1990), Amery Ice-Shelf (NUMANAMI *ET AL.*, 1996), Enderby Land (POWELL, 1958), 24° E (OKUTANI, 1986), cited *ca.* 10° E (GRIFFITHS *ET AL.*, 2003) and Bouvet Island (THIELE AND JAECKEL, 1931; SOOT-RYEN, 1951); from 6 m (DELL, 1990) to 1814 m (new record).

Limatula pygmaea (Philippi, 1845) (Fig. 95)

Lima pygmaea Philippi, 1845: 56; Smith, 1885: 292; Melvill and Standen, 1907: 148; Thiele, 1912: 251, pl. 17, figs. 6-8.

Radula pygmaea: Smith, 1879: 191, pl. 10, fig. 16; Lamy, 1906b: 15; 1911a: 22.

Limatula pygmaea: Powell, 1957: 116; Dell, 1964: 182, pl. 2, fig. 13; Arnaud, 1973: 557; Dell, 1990: 55; Branch *et al.*, 1991: 50 (key); Linse, 1997: 52; Troncoso *et al.*, 2001: 109, fig. 37; Page and Linse, 2002: 819 (table, text); Linse and Page, 2003: 290, figs. 1a-c (prodissoconch); Allen, 2004: 2647.

Limea martiali Mabille and Rochebrune, 1889: 124.

Lima falklandica Adams, 1864: 509; Thiele and Jaeckel, 1931: 167.

Limatula falklandica: Soot-Ryen, 1951: 21; Dell, 1964: 183.

Material studied: 5 spm. (6.2 x 4.6 - 8.1 x 6.3 mm), PA20; 1 spm. (7.5 x 6.0 mm), LOW.

Remarks: This species resembles *L. ovalis* (Thiele, 1912), which is smaller and narrower. In this sense, PAGE AND LINSE (2002) considered them sister species, not synonyms, utilizing molecular techniques; but ALLEN (2004) referred to *L. ovalis* as a junior synonym of *L. pygmaea* without mentioning the matter. LINSE AND PAGE (2003) also evidenced the development of species by means of observation to prodissoconchs, concluding that both *L. ovalis* and *L. pygmaea* having direct brooding development. The synonymies of *Limea martiali* Mabille and Rochebrune, 1889 and *L. falklandica* (Adams, 1864) are accepted (see DELL, 1990).

Distribution: South Sandwich (SOOT-RYEN, 1951), South Georgia (DELL, 1990) and South Orkney Islands (MELVILL AND STANDEN, 1907; DELL, 1990), Burdwood Bank, South Atlantic Ocean (DELL, 1990) and Falkland/Malvinas Islands, Beagle Channel (LINSE, 1997) and Cape Horn (MABILLE AND ROCHEBRUNE, 1889; DELL, 1990), Staten Island, Magellan Strait and Tierra del Fuego Island (DELL, 1990), South Shetland Islands (SOOT-RYEN, 1951; DELL, 1990; this study), Western Antarctic Peninsula (LAMY, 1906b, 1911a; SOOT-RYEN, 1951; DELL, 1990; this study) and Bellingshausen Sea (DELL, 1990), Macquarie Island (Tomlin 1948 in POWELL, 1960), Terre Adélie (GRIFFITHS *ET AL.*, 2003), Kerguelen Islands (SMITH, 1879; SMITH, 1885; THIELE, 1912; THIELE AND JAECKEL, 1931; POWELL, 1957; TRONCOSO *ET AL.*, 2001), Marion and Prince Edward Islands (SMITH, 1885; BRANCH *ET AL.*, 1991); from 3 m (MELVILL AND STANDEN, 1907) to 3714 m (DELL, 1990).

Limatula simillima Thiele, 1912 (Fig. 96)

Limatula simillima Thiele, 1912: 226, pl. 17, fig. 4; Soot-Ryen, 1951: 20; Powell, 1958: 177; Dell, 1964: 185, pl. 2, fig. 12; Nicol, 1966: 46, pl. 4, fig. 8; Dell, 1990: 53, fig. 97; Branch *et al.*, 1991: 50 (key); Page and Linse, 2002: 819 (table, text); Linse and Page, 2003: 290, fig. 1f (prodissoconch); Allen, 2004: 2648.
Limatula similliana (sic): Hain, 1990: 92, pl. 14, figs. 2a-c.

Material studied: 2 spm. (6.8 x 4.8 - 8.3 x 6.0 mm), MB31; 1 spm. (broken), MB37.

Remarks: LINSE AND PAGE (2003) established an indirect mode of development with lecitotrophic larvae. Molecular techniques allowed the establishing of its phylogenetic distance from other species (PAGE AND LINSE, 2002), which is reflected externally by having a more elongated shell.

Distribution: Weddell Sea (HAIN, 1990), Bellingshausen Sea (new record), Ross Sea (DELL, 1990), Davis Sea (THIELE, 1912), Mac Robertson to Enderby Land (POWELL, 1958) and Marion and Prince Edward Islands (BRANCH *ET AL.*, 1991); from 64 m (DELL, 1990) to 1426 m (new record).

Order OSTREIDA Férussac, 1822
Family PECTINIDAE Rafinesque, 1815
Genus *Adamussium* Thiele, 1934

Adamussium colbecki (Smith, 1902)

Pecten colbecki Smith, 1902: 212, pl. 25, fig. 11; 1907b: 6, pl. 3, figs. 9-9a; Melvill and Standen, 1907: 146; Hedley, 1911: 3; Lamy, 1911a: 23; Thiele, 1912: 225, pl. 17, figs. 1-1a.
Chlamys colbecki: Smith, 1915: 77; Hedley, 1916: 22.
Adamussium colbecki: Soot-Ryen, 1951: 16; Powell, 1958: 176; Nicol, 1966: 40, pl. 2, fig. 7, pl. 3, figs. 1, 7; Arnaud, 1973: 556; Egorova, 1982: 64, figs. 275-280; Dell, 1990: 35, figs. 59-60; Hain, 1990: 89, fig. 4.2; Numanami *et al.*, 1996: 212 (table, text), pl. 4, fig. 6.
Pecten racovitzai Pelseneer, 1903: 27, pl. 8, figs. 101-102; Lamy, 1906b: 16, pl. 1, fig. 19-21.

Material studied: 1 sh. (broken), MB2; 2 sh. (broken), MB3; 1 sh. (broken), PI5; 1 sh. (broken), PI7; 4 sh. (broken), MB26; 13 sh. (broken), MB30; 10 sh. (broken), MB31; 1 sh. (broken), MB34; 2 sh. (broken), MB35; 1 sh. (broken), MB36.

Remarks: All specimens of BENTART cruises correspond to fragmented shells, and these were not photographed since this is a well-known species illustrated in several works. The synonymy of *Pecten racovitzai* Pelseneer, 1903 was

suggested by LAMY (1911a) and accepted in subsequent works.

Distribution: Weddell Sea (MELVILL AND STANDEN, 1907; DELL, 1990; HAIN, 1990), South Sandwich, South Orkney and South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (LAMY, 1906b, 1911a; DELL, 1990), Bellingshausen Sea (PELSENEER, 1903; this study) and Peter I Island (SOOT-RYEN, 1951; this study), Scott and Balleny Islands (GRIFFITHS *ET AL.*, 2003), Ross Sea (SMITH, 1902; SMITH, 1907b; HEDLEY, 1911; SMITH, 1915; DELL, 1990), Commonwealth to Terre Adélie and Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982), Mac Robertson to Enderby Land (POWELL, 1958), Syowa (NUMANAMI *ET AL.*, 1996) and *ca.* 10º E (GRIFFTITHS *ET AL.*, 2003); from 2 m (EGOROVA, 1982) to 4545 m (MELVILL AND STANDEN, 1907).

Genus *Hyalopecten* Verril, 1897

Hyalopecten pudicus (Smith, 1885) (Fig. 97)

Pecten pudicus Smith, 1885: 302, pl. 21, figs. 8-8b; Pelseneer, 1903: 26.
Pecten undatus Verrill and Smith, in Verrill, 1885: 444, pl. 44, fig. 8.
Hyalopecten undatus: Dell, 1990: 37.
Hyalopecten dilectus Verrill and Bush, in Verrill, 1897: 80.

Material studied: 1 spm. (16.5 x 17.0 mm), MB38.

Remarks: This species was assigned to *Hyalopecten* after CARCELLES (1953). DELL (1990) considered *Hyalopecten dilectus* Verrill and Bush, 1897 as a junior synonym and cited it for several Antarctic points, though it seems to have a greater distribution. *Hyalopecten arntzi* Egorova, 1999, from the Weddell Sea, is very similar, but according to its author, the main difference is in the concavity of the shell, greater than in *H. pudicus* and in the distinct size of the ears.

Distribution: South Sandwich Islands (DELL, 1990), cited for the Burdwood Bank and the South Shetland Islands (CARCELLES, 1953), Bellingshausen Sea (PELSENEER, 1903; this study), South Tasmania (48º S, 148º E) (DELL, 1990) and Marion Island (SMITH, 1885); from 400 m (PELSENEER, 1903) to 5453 m (DELL, 1990).

Family PROPEAMUSSIIDAE Abbott, 1954
Genus *Cyclochlamys* Finlay, 1926

Cyclochlamys gaussianus (Thiele, 1912) (Fig. 98)

Camptonectes gaussianus Thiele, 1912: 226, pl. 17, fig. 2; Dijkstra and Köhler, 2008: 37, fig. 1c.
Cyclopecten gaussianus: Egorova, 1982: 65, figs. 281-282; Hain, 1990: 89, pl. 13, figs. 4a-c; Numanami *et al.*, 1996: 212 (table, text), pl. 4, figs. 4, 7.

Material studied: 2 spm. (1.2 x 1.1 - 2.8 x 2.7 mm), PA39.

Remarks: Several species have been described from the Southern Ocean, being necessary a revision of the group since the unknowns status of some species. The individuals found agree with THIELE's description (1912), with EGOROVA's figures (1982) and with the specimens figured by HAIN (1990) and NUMANAMI *ET AL.* (1996). The taxonomic position of this species is *Cyclochlamys gaussianus* (Thiele, 1912) (DIJKSTRA AND KÖHLER, 2008).

Distribution: Weddell Sea (HAIN, 1990), Western Antarctic Peninsula (new

record), Davis Sea (THIELE, 1912; EGOROVA, 1982) and Syowa (NUMANAMI ET AL., 1996); from 157 m (new record) to 481 m (HAIN, 1990).

Genus *Cyclopecten* Verrill, 1897

Cyclopecten notalis (Thiele, 1912) (Fig. 99)

Camptonectes notalis Thiele, 1912: 251, pl. 17, figs. 3-3a; Dijkstra and Köhler, 2008: 39, fig. 1f.
Palliolum notalis: Egorova, 1982: 64, figs. 283-284.

Material studied: 1 spm. (4.1 x 4.0 mm), PI27; 4 spm. (3.0 x 3.0 - 7.0 x 6.9 mm), MB38.

Remarks: Although it has been reported only by THIELE (1912) and redrawn by EGOROVA (1982), the description agrees with BENTART individuals. According to DIJKSTRA AND KÖHLER (2008) it belongs to Propeamussiidae as *Cyclopecten notalis* (Thiele, 1912).

Distribution: Bellingshausen Sea, Peter I Island (new records) and Davis Sea (THIELE, 1912); from 1324 m (new record) to 3423 m (THIELE, 1912).

Cyclopecten pteriola (Melvill and Standen, 1907) (Fig. 100)

Pecten pteriola Melvill and Standen, 1907: 147, figs. 16-16a.
Cyclopecten pteriola: Soot-Ryen, 1951: 16; Dell, 1964: 141, fig. 1 (N°1); Hain, 1990: 90, pl. 13, figs. 5a-c.

Material studied: 1 spm. (4.6 x 4.2 mm), MB36.

Remarks: The inequilateral shell and marked concentric ridges of *Cyclopecten pteriola* are conclusive to attribute the species, which has been seldom recorded.

Distribution: Weddell Sea (HAIN, 1990), South Orkney Islands (MELVILL AND STANDEN, 1907) and Bellingshausen Sea (new record); from 16 m (MELVILL AND STANDEN, 1907) to 560 m (new record).

Subclass HETERODONTA Neumayr, 1884
Order VENERIDA Adams and Adams, 1856
Family THYASIRIDAE Dall, 1901
Genus *Genaxinus* Iredale, 1930

Genaxinus debilis (Thiele, 1912) (Fig. 101)

Axinopsis debilis Thiele, 1912: 232, pl. 18, figs. 25-25a; Hedley, 1916: 27; Soot-Ryen, 1951: 30.
Genaxinus debilis: Dell, 1964: 208; Arnaud, 1973: 557; Egorova, 1982: 70, figs. 314-315; Dell, 1990: 57, figs. 93-94.
Genaxinus bongraini (Lamy): Nicol, 1966: 63, pl. 6, figs. 1-2 (no Lamy, 1910).

Material studied: 107 spm. (1.8 x 1.6 - 3.3 x 3.3 mm), PI5; 141 spm. (2.0 x 1.9 - 3.1 x 3.0 mm), PI6; 40 spm. (1.7 x 1.6 - 2.8 x 2.6 mm), PI7; 49 spm. (2.0 x 1.8 - 3.3 x 3.0 mm), PI8; 5 spm. (2.0 x 1.9 - 3.0 x 2.9 mm), PA21; 4 spm. (2.1 x 2.1 - 2.9 x 2.7 mm), PA22; 1 spm. (broken), PA25; 58 spm. (1.0 x 0.9 - 2.1 x 2.0 mm), PI27; 1 spm. (1.1 x 1.1 mm), PI28; 1 spm. (2.1 x 2.1 mm), MB34; 1 spm. (2.0 x 2.0 mm), MB36; 7 spm. (1.6 x 1.5 - 1.9 x 1.8 mm), MB38; 8 spm. (1.1 x 1.0 - 2.1 x 2.1 mm), PA39; 6 spm. (1.1 x 0.9 - 1.8 x 1.7 mm), PA41; 1 spm. (1.5 x 1.4 mm), PA42; 244 spm. (1.9 x 1.8 - 3.8 x 3.9 mm), DEC.

Remarks: This species resembles *T. dearborni* Nicol, 1965, which differs in having a more developed posterior sinus, being larger, with weaker concentric striae and having the anterior border shorter and straighter. DELL (1990) commented that NICOL's (1966) specimens, reported as *Genaxinus bongraini*, corresponded to *G. debilis*. HAIN (1990) cited this species as a junior synonym of *T. bongraini* (Lamy, 1910).

Distribution: South Sandwich, South Georgia, South Orkney, Falkland/Malvinas and Tierra del Fuego Islands, and Eastern Antarctic Peninsula (DELL, 1990), South Shetland Islands, Western Antarctic Peninsula and Bellingshausen Sea (DELL, 1990; this study), Peter I Island (new record), Ross Sea (DELL, 1990), Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (THIELE, 1912; EGOROVA, 1982) and Mac Robertson Land (DELL, 1990); from 9 m (DELL, 1990) to 1873 m (new record).

Genus *Thyasira* Leach in Lamarck, 1818

Thyasira bongraini (Lamy, 1910) (Fig. 102)

Axinus bongraini Lamy, 1910b: 389; 1911a: 17, pl. 1, fig. 17;
Thyasira bongraini: Soot-Ryen, 1951: 30; Egorova, 1982: 70, figs. 311-313.
Thyasira cf. *bongraini* (Lamy): Dell, 1964: 207, fig. 4 (Nº10-11).
Genaxinus bongraini: Hain, 1990: 96, pl. 14, figs. 8a-b.

Material studied: 2 spm. (2.0 x 1.9 - 3.1 x 3.0 mm), PI6; 7 spm. (3.0 x 2.9 - 7.0 x 7.0 mm), PA22; 1 spm. (5.2 x 5.4 mm), DEC.

Remarks: *T. dearborni* Nicol, 1965 may be a junior synonym of *T. bongraini*, because DELL's (1964) specimens, cited as *T.* cf. *bongraini*, have all the characteristics of the species, and DELL (1990, p. 56, figs. 91-92) detailed and figured individuals from Ross Sea assigned to *T. dearborni*, that agree with the original description of *T. bongraini*. HAIN (1990) reported specimens collected in the Weddell Sea and he named *Genaxinus bongraini* as well, but as a senior synonym of *G. debilis* (Thiele, 1912). Summarizing, a revision of the genus in the Southern Ocean is necessary.

Distribution: Weddell Sea (HAIN, 1990), South Shetland Island (new record), Western Antarctic Peninsula (LAMY, 1911a; SOOT-RYEN, 1951; this study), Peter I Island (SOOT-RYEN, 1951; this study), Davis Sea (EGOROVA, 1982) and Bouvet Island (LINSE, 2006); from 9 to 850 m (HAIN, 1990). *T. dearborni* has been cited in the South Orkney and the South Shetland Islands, Western Antarctic Peninsula and the Ross Sea (DELL, 1990); from 39 to 1180 m (DELL, 1990).

Family CARDITIDAE Fleming, 1828
Genus *Cyclocardia* Conrad, 1867

Cyclocardia astartoides (Martens, 1878) (Fig. 103)

Cardita astartoides Martens, 1878: 25; Smith, 1885: 212, pl. 15, figs, 2-2c; Smith, 1902: 211; Lamy, 1906b: 14; Smith, 1907b: 2; Hedley, 1911: 3; Lamy, 1911a: 21; Thiele, 1912: 230, pl. 18, fig. 10; Smith, 1915: 77.
Venericardia astartoides: Hedley, 1916: 30, pl.3, figs. 33-34; Thiele and Jaeckel, 1931: 216.
Cyclocardia astartoides: Soot-Ryen, 1951: 25; Powell, 1957: 121; 1958: 177; Dell, 1964: 189; Nicol, 1966: 49, pl. 4, fig. 1, pl. 5, figs. 1-2; Arnaud, 1973: 558; Egorova, 1982: 72, figs. 331-333; Okutani, 1986: 279 (table), pl. 2, figs. 16, 22; Dell, 1990: 59, figs. 98-99; Hain, 1990: 94, pl. 14, figs. 4a-b; Numanami *et al.*, 1996: 211 (table), 213 (text), pl. 4, fig. 5; Troncoso *et al.*, 2001: 109, fig. 38.

Cardita antarctica Smith, 1907b: 2, pl. 2, figs. 15-15a.
Cyclocardia antarctica: Soot-Ryen, 1951: 24.

Material studied: 3 spm. (6.1 x 5.8 - 8.9 x 10.1 mm), MB4; 6 spm. (8.3 x 6.8 - 20.5 x 16.3 mm), PA20; 2 spm. (6.7 x 5.2 - 8.2 x 6.4 mm), PA21; 2 spm. (8.0 x 6.7 - 14.0 x 10.9 mm), PA25; 1 spm. (3.5 x 3.5 mm), MB37; 5 spm. (0.9 x 0.9 - 9.0 x 7.0 mm), PA39; 4 spm. (1.1 x 1.1 - 24.0 x 19.1 mm), LOW.

Remarks: DELL (1964) remarked that *C. astartoides* has variations according to geographic distribution, being possibly the senior synonym of the species *C. intermedia* (Thiele, 1912) and *C. antarctica* (Smith, 1907). The same author (DELL, 1990) validated the synonymy of *C. antarctica*, but left in doubt the synonymy of *C. intermedia*; Hain (1990) included *C. intermedia* as a junior synonym of *C. astartoides*, though EGOROVA (1982) reported it as a valid species. In this study we only considered *C. antarctica* in the synonymy of *C. astartoides*, following DELL (1990) who examined many specimens from several localities.

Distribution: Weddell Sea (SOOT-RYEN, 1951; HAIN, 1990), South Sandwich (DELL, 1990), South Georgia (SOOT-RYEN, 1951; CARCELLES, 1953; DELL, 1990), South Orkney (DELL, 1990) and South Shetland Islands (SOOT-RYEN, 1951; DELL, 1990; this study), Western Antarctic Peninsula (LAMY, 1906b; LAMY, 1911a; DELL, 1990; this study), Bellingshausen Sea to off Thurston Island (new records), Beagle Channel and Magellanic Area (GRIFFITHS *ET AL.*, 2003), Ross Sea (SMITH, 1902; SMITH, 1907b; HEDLEY, 1911; SMITH, 1915; DELL, 1990) to 163° E (SMITH, 1915), Balleny and Macquarie Islands (DELL, 1990), Terre Adélie (POWELL, 1958), Wilkes Land (DELL, 1990), Shackleton Ice Shelf (HEDLEY, 1916) to Davis Sea (THIELE, 1912; EGOROVA, 1982), Heard Island (SMITH, 1885) to Kerguelen Islands (SMITH, 1885; THIELE AND JAECKEL, 1931; POWELL, 1957; DELL, 1990; TRONCOSO *ET AL.*, 2001), Amery Ice Shelf (NUMANAMI *ET AL.*, 1996), Mac Robertson to Enderby Land (POWELL, 1958), Syowa (NUMANAMI *ET AL.*, 1996), 24° E (OKUTANI, 1986) and cited *ca.* 10° E (GRIFFITHS *ET AL.*, 2003), and Bouvet Island (SOOT-RYEN, 1951; LINSE, 2006); from 2 m (HAIN, 1990) to 3248 m (DELL, 1990).

Family GALEOMMATIDAE Gray, 1840
Genus *Mysella* Angas, 1877

Mysella antarctica (Smith, 1907) (Figs. 104-105)

Tellimya antarctica Smith, 1907b: 3, pl. 2, figs. 16-16b; 1915: 78.
Mysella antarctica: Soot-Ryen, 1951: 33; Dell, 1964: 216, fig. 3 (N°12, 19); Dell, 1990: 42, figs. 78-79; Linse, 1997: 56.

Material studied: 2 spm. (1.1 x 1.0 - 2.2 x 1.8 mm), PA41; 1 spm. (1.9 x 1.4 mm), PA42; 3 spm. (2.1 x 1.7 - 2.8 x 2.1 mm), DEC.

Remarks: The specimens agree with the original description of SMITH (1907b), with strong and short teeth, globose form and well defined umbo due to the concavity of the dorsal-posterior margin; however, they do not agree with the specimens figured by DELL (1990, figs. 78-79), whose teeth are long and narrow and the dorsal-posterior and anterior margins straighter. Several species have been described from the neighboring areas; in this sense, *M. ovalis* (Thiele, 1912) is very similar, though according to the original figures it is less elongated and it has a less concave dorsal-posterior margin. *M. gibbosa* (Thiele, 1912) has the hinge with small and subequal teeth and the dorsal-posterior margin almost straight. *M.*

narchii Dias-Passos and Domaneschi, 2006 differs in having a very long anterior tooth and a shorter posterior.

Distribution: South Shetland Islands (DELL, 1990; this study) and Western Antarctic Peninsula (new record), Beagle Channel (LINSE, 1997), Ross Sea (SMITH, 1907b; SMITH, 1915; DELL, 1990) and Wilkes Land (DELL, 1990); from 29 m (DELL, 1990) to 1272 m (new record).

Mysella gibbosa (Thiele, 1912) (Figs. 106-107)

Tellimya gibbosa Thiele, 1912: 230, pl. 18, figs. 12-12a.
Mysella gibbosa: Soot-Ryen, 1951: 33; Egorova, 1982: 71, figs. 307-308; Dell, 1990: 45, figs. 74-75.

Material studied: 3 spm. (1.6 x 1.1 - 3.9 x 3.1 mm), MB36.

Remarks: Hinge of the right valve with two, short subequal teeth. The teeth of the hinge and the shape of the shell differ from similar species (see above the remarks on *M. antarctica*).

Distribution: Bellingshausen Sea (new record), Ross Sea (DELL, 1990), Davis Sea (THIELE, 1912; EGOROVA, 1982) and Mac Robertson Land (DELL, 1990); from 64 to 752 m (DELL, 1990).

Genus *Pseudokellya* Pelseneer, 1903

Pseudokellya cardiformis (Smith, 1885) (Fig. 108)

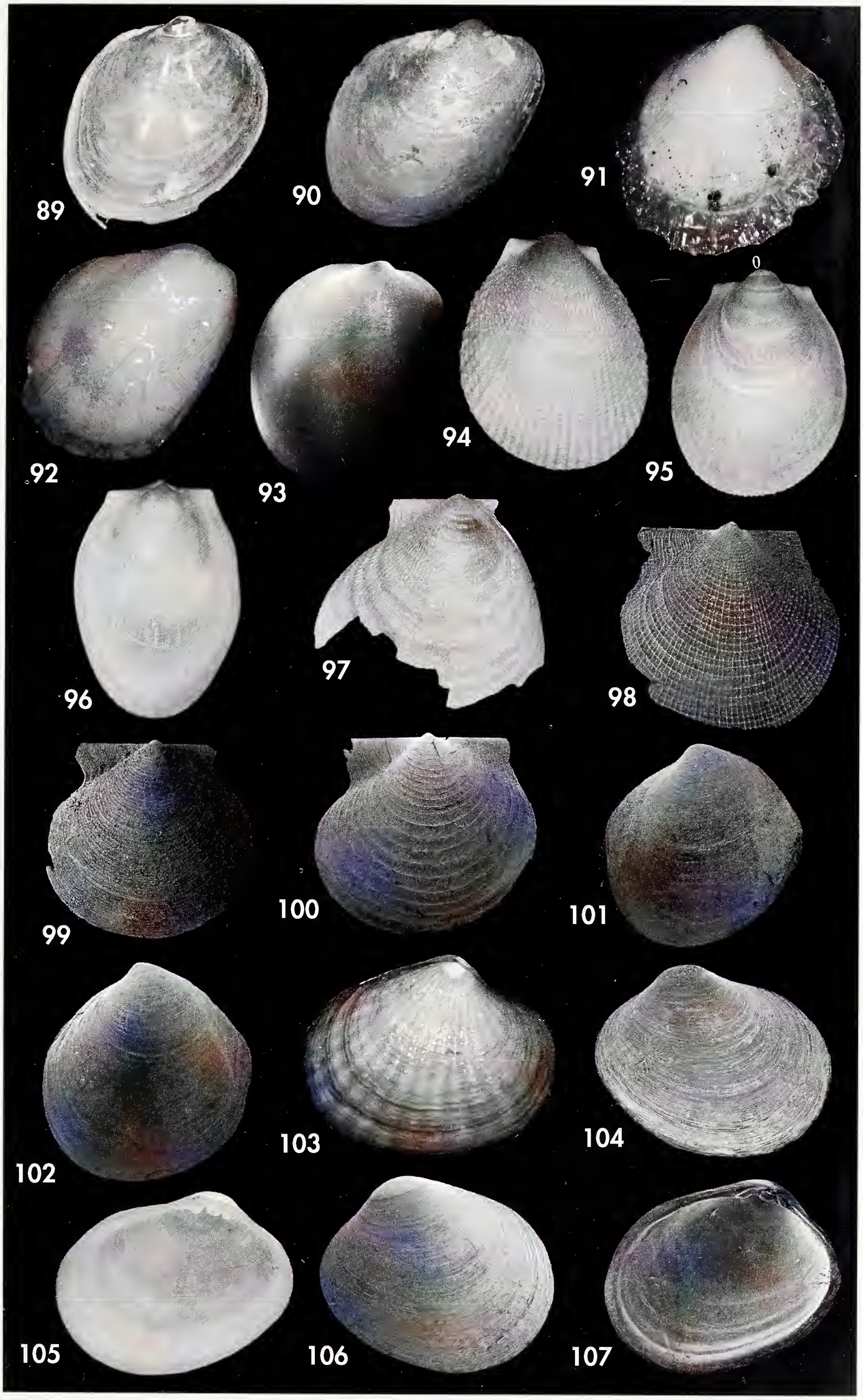
Kellya cardiformis Smith, 1885: 202, pl. 11, figs. 6-6b.
Pseudokellya cardiformis: Pelseneer, 1903: 48; Lamy, 1911a: 20; Thiele and Jaeckel, 1931: 223; Soot-Ryen, 1951: 28; Powell, 1957: 122; Dell, 1964: 199, pl. 6, figs. 3-4; 1990: 40, figs. 66-67; Hain, 1990: 98, pl. 15, figs. 3a-b; Troncoso *et al.*, 2001: 107, fig. 34.
Pseudokellya stillwelli Hedley, 1916: 31, pl. 3, figs. 38-39; Soot-Ryen, 1951: 28; Dell, 1964: 200; Nicol, 1966: 56, pl. 6, fig. 3, pl. 7, fig. 4; Egorova, 1982: 72, figs. 326-327.

Material studied: 1 spm. (4.1 x 4.1 mm), PA21.

Remarks: NICOL (1966) and DELL (1990) suggested that *P. stillwelli* Hedley, 1916 is part of the variability of this species regarding the strength of sculpture, and is,therefore, a synonym.

Distribution: Weddell Sea (HAIN, 1990), South Sandwich and South Georgia Islands, Burdwood Bank, Falkland/Malvinas and South Shetland Islands (DELL, 1990), Western Antarctic Peninsula (LAMY, 1911a; DELL, 1990; this study), Ross Sea (DELL, 1990), Macquarie Island (CARCELLES, 1953), Terre Adélie (HEDLEY, 1916), Davis Sea (HEDLEY,

(Right page) Figure 89. *Adacnarca nitens*, 4.2 x 3.8 mm, PA21. Figure 90. *Lissarca notorcadensis*, 7.0 x 6.6 mm, PA21. Figure 91. *Philobrya sublaevis*, 10.5 x 11.0 mm, PI8. Figure 92. *Philobrya wandelensis*, 3.2 x 2.5 mm, PA20. Figure 93. *Dacrydium albidum*, 2.6 x 3.2 mm, MB30. Figure 94. *Limatula hodgsoni*, 11.5 x 9.3 mm, PA20. Figure 95. *Limatula pygmaea*, 6.2 x 4.6 mm, PA20. Figure 96. *Limatula simillima*, 6.8 x 4.8 mm, MB31. Figure 97. *Hyalopecten pudicus*, 16.5 x 17.0 mm, MB38. Figure 98. *Cyclochlamys gaussianus*, 2.5 x 2.3 mm, PA39. Figure 99. *Cyclopecten notalis*, 6.7 x 6.4 mm, MB38. Figure 100. *Cyclopecten pteriola*, 4.6 x 4.2 mm, MB36. Figure 101. *Genaxinus debilis*, 2.3 x 2.3 mm, PI7. Figure 102. *Thyasira bongraini*, 3.6 x 3.8 mm, PA22. Figure 103. *Cyclocardia astartoides*, 20.5 x 16.3 mm, PA20. Figures 104, 105. *Mysella antarctica*, 2.7 x 2.1 mm, DEC. Figures 106, 107. *Mysella gibbosa*, 3.0 x 2.4 mm, MB36.
(Página derecha) Figuras 89-107. Ver los nombres científicos en el rótulo en inglés.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1916; EGOROVA, 1982), Kerguelen Islands (SMITH, 1885; THIELE AND JAECKEL, 1931; POWELL, 1957; TRONCOSO *ET AL.*, 2001) and cited for Marion and Prince Edward Islands (CARCELLES, 1953); from 20 m (POWELL, 1957) to 710 m (DELL, 1990).

Family CYAMIIDAE Philippi, 1845
Genus *Cyamiocardium* Soot-Ryen, 1951

Cyamiocardium denticulatum (Smith, 1907) (Fig. 109)

Cyamium denticulatum Smith, 1907b: 3, pl. 3, figs. 4, 4b; Lamy, 1911a: 19; Melvill and Standen, 1912: 363.
Cyamiocardium denticulatum: Powell, 1951: 116; Soot-Ryen, 1951: 26; Powell, 1957: 116; 1958: 175; Dell, 1964: 203; Arnaud, 1973: 558; Dell, 1990: 50, figs. 80-83; Hain, 1990: 95, pl. 14, figs. 6a-b; Linse, 1997: 56.

Material studied: 1 spm. (broken), MB4; 292 spm. (2.0 x 1.9 - 5.7 x 5.5 mm), PI5; 2 spm. (3.0 x 2.9 - 3.1 x 3.0 mm), PI7; 153 spm. (2.1 x 1.9 - 5.0 x 4.9 mm), PI8; 1 spm. (broken), PA21; 6 spm. (1.5 x 1.4 - 2.0 x 2.0 mm), PA41; 4 spm. (1.1 x 1.1 - 1.8 x 1.7 mm), PA42; 1 spm. (2.1 x 2.0 mm), PA43.

Remarks: Other similar species in Antarctic and Sub-Antartic waters are *Perrierina crassilabrum* Dell, 1964, *C. dahli* Soot-Ryen, 1957 and *C. rotundatum* (Thiele, 1912), which differ by having more prominent radial sculpture (*P. crassilabrum* and *C. rotundatum*), or by its equilateral shape with central umbo (*C. dahli*). *C. denticulatum* exhibits more prominent growth lines, a fainter radial sculpture and a subcentral umbo.

Distribution: Weddell Sea in 23-573 m (HAIN, 1990), South Orkney (Dell, 1990) and Falkland/Malvinas Islands (MELVILL AND STANDEN, 1912), Burdwood Bank (MELVILL AND STANDEN, 1912; DELL, 1990) and South Atlantic Ocean (54° S, 64° W) (DELL, 1990), Beagle Channel (LINSE, 1997), Tierra del Fuego Island, South Shetland Islands (DELL, 1990) and Western Antarctic Peninsula (LAMY, 1911a; DELL, 1990; this study), Peter I Island (SOOT-RYEN, 1951; this study), off Thurston Island (new record), Ross Sea (SMITH, 1907b; DELL, 1990), *ca.* Terre Adélie (GRIFFITHS *ET AL.*, 2003), Davis Sea (DELL, 1990), Kerguelen Islands (POWELL, 1957), Mac Robertson to Enderby Land (POWELL, 1958) and Bouvet Island (SOOT-RYEN, 1951; LINSE, 2006); from 5 m (DELL, 1990) to 1272 m (new record). Despite its widespread distribution, it has not been cited in the South Georgia and South Sandwich Islands (DELL, 1990).

Genus *Cyamiomactra* Bernard, 1897

Cyamiomactra laminifera (Lamy, 1906) (Fig. 110)

Mactra laminifera Lamy, 1906a: 45.
Cyamiomactra laminifera: Lamy, 1906b: 11, pl. 1, figs. 10-12; 1911a: 18; Soot-Ryen, 1951: 28; Dell, 1964: 202, pl. 6, fig. 9-10; Nicol, 1966: 51, pl. 7, figs. 1, 7-8; Dell, 1990: 50, fig. 100.
Cyamium laminifera: Thiele, 1912: 270.
Diplodonta incerta Smith, 1907b: 4, pl. 3, figs. 5-5a.
Cyamiomactra robusta Nicol, 1964: 60, pl. 6, figs. 1-3; 1966: 53, pl. 8, figs. 1, 6-7; Hain, 1990: 95, pl. 14, figs. 5a-b.

Material studied: 1 spm. (5.6 x 4.1 mm), PI8; 1 spm. (6.3 x 5.0 mm), PA20; 1 spm. (10.0 x 7.1 mm), MAR.

Remarks: The synonymy of *Cyamiomactra robusta* Nicol, 1964 was suggested by DELL (1990) based on the variability of the postero-ventral rib, the same as *Diplodonta incerta* Smith, 1907, whose synonymy was accepted before.

Distribution: Weddell Sea (HAIN, 1990), South Sandwich (SOOT-RYEN, 1951), South Georgia (DELL, 1990) and South Orkney Islands (CARCELLES, 1953), South Atlantic Ocean (51° S, 44° W) and Falkland/Malvinas Islands (DELL, 1990), South Shetland Islands (LAMY, 1911a; SOOT-RYEN, 1951; DELL, 1990) and Western Antarctic Peninsula (LAMY, 1906b; LAMY, 1911a; DELL, 1990; this study), Bellingshausen Sea (DELL, 1990), Peter I Island (SOOT-RYEN, 1951; this study) and Ross Sea (SMITH, 1907b; DELL, 1990); from 15 to 1281 m (DELL, 1990).

Subclass ANOMALODESMATA Dall, 1889
Order PHOLADOMYIDA Newell, 1965
Family LYONSIIDAE Fischer, 1887
Genus *Lyonsia* Turton, 1822

Lyonsia arcaeformis Martens, 1885 (Fig. 111)

Lyonsia arcaeformis Martens, 1885: 94; Martens and Pfeffer, 1886: 113, pl. 4, fig. 1; Dell, 1964: 226; Nicol, 1966: 69, pl. 9, figs. 1, 3, 9; Dell, 1972: 27, fig. 28; 1990: 63, figs. 116-117; Hain, 1990: 100, pl. 15, figs. 6a-b.
Entodesma arcaeformis: Soot-Ryen, 1951: 21.
Lyonsiella planulata Thiele, 1912: 232, pl. 18, figs. 27-27a; Soot-Ryen, 1951: 22; Powell, 1958: 178; Egorova, 1982: 68, figs. 300-301.
Lyonsia planulata: Nicol, 1966: 69, pl. 9, figs. 1, 3, 9.
Pholadomya mawsoni Hedley, 1916: 28, pl. 3, figs. 29-30; Soot-Ryen, 1951: 21; Nicol, 1966: 71.

Material studied: 1 spm. (11.1 x 7.0 mm), PA39; 3 spm. (5.2 x 3.6 - 10.9 x 6.0 mm), DEC.

Remarks: DELL (1964) included *Pholadomya mawsoni* Hedley, 1916 as a junior synonym, and DELL (1972) *Lyonsia planulata* (Thiele, 1912). According to POWELL (1960) the specimen of *Entodesma cuneata* (Gray, 1828) from Falkland/Malvinas Islands reported by MELVILL AND STANDEN (1907, p. 151) corresponds to *L. arcaeformis*.

Distribution: Weddell Sea (HAIN, 1990), South Sandwich (DELL, 1990), South Georgia (MARTENS AND PFEFFER, 1886; DELL, 1990), South Orkney (DELL, 1990) and probably in the Falkland/Malvinas Islands (POWELL, 1960) and Burdwood Bank (CARCELLES, 1953), South Shetland Islands and Western Antarctic Peninsula (DELL, 1990; this study), Amundsen Sea (70° S, 106° W) (DELL, 1990), Ross Sea (DELL, 1972, 1990), Terre Adélie, Shackleton Ice Shelf (HEDLEY, 1916) and Davis Sea (THIELE, 1912; EGOROVA, 1982), Enderby Land (POWELL, 1958) and Bouvet Island (LINSE, 2006); from 12 to 1812 m (DELL, 1990).

Family POROMYIDAE Dall, 1886
Genus *Poromya* Forbes, 1844

Poromya adelaidis (Hedley, 1916) (Fig. 112)

Pholadomya adelaidis Hedley, 1916: 28, pl. 3, figs. 31-32; Soot-Ryen, 1951: 21; Powell, 1958: 178; Dell, 1964: 227; Egorova, 1982: 67, figs. 294-296.
Poromya adelaidis: Dell, 1990: 61, figs. 107-108.
Poromya cf. *adelaides* (sic): Hain, 1990: 102, pl. 16, fig. 1.

Material studied: 2 spm. (18.9 x 13.4 - 21.0 x 14.3 mm), PA43; 3 spm. (23.1 x 17.0 - 28.1 x 19.8 mm), LOW; 1 spm. (22.1 x 17.4 mm), DEC.

Remarks: DELL (1990, p. 61) comments that the relationship between *P. adelaidis*, *P. spinosula* (Thiele, 1912) and *P. antarctica* (Hedley, 1916) is still not clear.

Distribution: Weddell Sea (HAIN, 1990), South Georgia and Falkland/Malvinas Islands, Cape Horn, South Shetland Islands (DELL, 1990; this study), Western Antarctic Peninsula (new record), Ross Sea (DELL, 1990), Terre Adélie, Shackleton Ice Shelf (HEDLEY, 1916), Davis Sea (EGOROVA, 1982) and Enderby Land (POWELL, 1958); from 110 m (HAIN, 1990) to 2154 m (DELL, 1990).

Family LATERNULIDAE Hedley, 1918
Genus *Laternula* Röding 1798

Laternula elliptica (King and Broderip, 1832) (Fig. 113)

Anatina elliptica King and Broderip, 1832: 335; Smith, 1885: 76; Smith, 1902; 210, pl. 25, figs. 9-10; Lamy, 1906b: 14; Melvill and Standen, 1907: 151; Smith, 1907b: 1, pl. 3, fig. 3; Hedley, 1911: 3; Lamy, 1911a: 21; Thiele, 1912: 256; Smith, 1915: 78; Thiele and Jaeckel, 1931: 244.

Laternula elliptica: Hedley, 1916: 27; Soot-Ryen, 1951: 22; Powell, 1957: 120; Dell, 1964: 229; Nicol, 1966: 74, pl. 10, figs. 1, 4, 7; Arnaud, 1973: 559; Egorova, 1982: 68, figs. 297-299; Okutani, 1986: 279, pl. 2, figs. 20-21; Dell, 1990: 62, fig. 106; Branch *et al*., 1991: 51 (key); Numanami *et al*., 1996: 212 (table, text), pl. 4, fig. 9; Troncoso *et al*., 2001: 110, fig. 41.

Material studied: 1 spm. (33.0 x 18.0 mm), PI5; 1 spm. (12.0 x 7.3 mm), LOW; 3 spm. (20.5 x 11.5 - 46.0 x 29.1 mm), DEC.

Distribution: Cited for the Weddell Sea (GRIFFITHS *ET AL*., 2003), South Sandwich (SOOT-RYEN 1951, DELL 1990), South Georgia (CARCELLES, 1953; DELL, 1990) and South Orkney Islands (MELVILL AND STANDEN, 1907; DELL, 1990), Eastern Antarctic Peninsula (DELL, 1990), South Shetland Islands (LAMY, 1911a; SOOT-RYEN 1951; DELL, 1990; this study), Western Antarctic Peninsula (LAMY, 1906b, 1911a; DELL, 1990) and Peter I Island (SOOT-RYEN, 1951; this study), Ross Sea (SMITH, 1902, 1907b; HEDLEY, 1911; SMITH, 1915; DELL, 1990), Commonwealth (HEDLEY, 1916), Wilkes Land (GRIFFITHS *ET AL*., 2003), Davis Sea (EGOROVA, 1982), Kerguelen Islands (SMITH, 1885; THIELE, 1912; THIELE AND JAECKEL, 1931; POWELL, 1957; TRONCOSO *ET AL*., 2001), Marion and Prince Edward Islands (BRANCH *ET AL*., 1991), Syowa (NUMANAMI *ET AL*., 1996) and *ca*. 10° E (GRIFFITHS *ET AL*., 2003); from 1 m (TRONCOSO *ET AL*., 2001) to 508 m (DELL, 1990).

Family THRACIIDAE Stoliczka, 1870
Genus *Thracia* Leach in Blainville, 1824

Thracia meridionalis Smith, 1885 (Fig. 114)

Thracia meridionalis Smith, 1885: 68, pl. 6, figs. 4-4b; Lamy, 1906b: 15; Smith, 1907b: 1; Hedley, 1911: 3; Lamy, 1911a: 22; Smith, 1915: 78; Hedley, 1916: 29; Soot-Ryen, 1951: 21; Powell, 1958: 178; Nicol, 1966: 71, pl. 10, figs. 2, 5; Arnaud, 1973: 559; Egorova, 1982: 69, figs. 304-306; Okutani, 1986: 279 (table), pl. 2, fig. 15; Dell, 1990: 63, figs. 109-111; Hain, 1990: 101, pl. 15, figs. 7a-b; Branch *et al*., 1991: 51 (key); Linse, 1997: 61; Troncoso *et al*., 2001: 112, fig. 42.

Mysella? truncata Thiele, 1912: 230, pl. 18, fig. 18.

Mysella? frigida Thiele, 1912: 231, pl. 18, fig. 19.

Material studied: 3 spm. (5.7 x 4.6 - 8.1 x 6.0 mm), PA21; 2 spm. (22.0 x 16.3 - 23.8 x 18.2 mm), LOW; 20 spm. (2.9 x 2.4 - 23.0 x 19.1 mm), DEC.

Remarks: The synonymy of Thiele's (1912) *Mysella? truncata* and *Mysella? frigida* were accepted in many previous works (see Dell, 1990).

Distribution: Weddell Sea (Soot-Ryen, 1951; Hain, 1990), South Sandwich (Dell, 1990), South Georgia (Carcelles, 1953; Dell, 1990) and cited for the South Orkney Islands (Linse, 1997), Falkland/Malvinas Islands, South Atlantic Ocean (54° S, 64° W), Cape Horn (Dell, 1990) and Beagle Channel (Linse, 1997), South Shetland Islands (Lamy, 1911a; Soot-Ryen, 1951; Dell, 1990; this study) and Western Antarctic Peninsula (Lamy, 1906b, 1911a; Soot-Ryen, 1951; Dell, 1990; this study), Ross Sea (Smith, 1907b; Hedley, 1911; Smith, 1915; Dell, 1990), Terre Adélie, Shackleton Ice Shelf (Hedley, 1916) to Davis Sea (Thiele, 1912; Egorova, 1982), Kerguelen Islands (Smith, 1885; Troncoso *et al.*, 2001), Mac Robertson to Enderby Land (Powell, 1958), Marion and Prince Edward Islands (Smith, 1885; Branch *et al.*, 1991), 24° E (Okutani, 1986) and *ca.* 10° E (Griffiths *et al.*, 2003); from 4 to 836 m (Dell, 1990).

Family Cuspidariidae Dall, 1886
Genus *Cuspidaria* Nardo, 1840

Cuspidaria infelix Thiele, 1912 (Fig. 115)

Cuspidaria infelix Thiele, 1912: 233, pl. 18, fig. 28; Hedley, 1916: 29; Thiele and Jaeckel, 1931: 255; Soot-Ryen, 1951: 23; Dell, 1964: 230; Nicol, 1966: 78, pl. 9, fig. 6; Egorova, 1982: 74, figs. 334-336; Dell, 1990: 68, figs. 112-114; Hain, 1990: 103, pl. 16, figs. 3a-f; Egorova, 1993: 153, pl. 1, figs. 2-6; Linse, 1997: 62.

Material studied: 1 spm. (broken), MB2; 24 spm. (4.3 x 2.9 - 10.0 x 6.9 mm), PI5; 3 spm. (6.0 x 3.7 - 27.1 x 17.0 mm), PI7; 13 spm. (4.4 x 3.0 - 9.2 x 6.1 mm), PI8; 1 spm. (16.3 x 8.1 mm), MB9; 2 spm. (4.0 x 2.6 - 12.7 x 7.8 mm), PA21; 1 spm. (7.1 x 4.1 mm), PA24; 2 spm. (13.9 x 8.5 - 16.5 x 10.1 mm), MB31; 3 spm. (6.0 x 3.7 - 17.9 x 10.9), MB34; 9 spm. (2.0 x 1.3 - 7.3 x 4.6 mm), MB36.

Remarks: Egorova (1993) studied the Antarctic species of cuspidariids; in this sense, *C. tenella* Smith, 1907, differs in being a larger, more globose species, having a posterior rostrum which is narrower and shorter. *Cuspidaria smirnovi* Egorova, 1998 differs in having more marked growth lines and a shorter and less marked rostrum.

Distribution: Weddell Sea (Hain, 1990), cited for the South Georgia and South Orkney Islands (Linse, 1997), South Shetland Islands (Dell, 1990), Western Antarctic Peninsula (Dell, 1990; this study), Peter I Island (Soot-Ryen, 1951; this study) and Bellingshausen Sea to off Thurston Island (new records), Beagle Channel (Linse, 1997), Ross Sea (Dell, 1990), Terre Adélie (Griffiths *et al.*, 2003), Shackleton Ice Shelf (Hedley, 1916), Davis Sea (Thiele, 1912; Egorova, 1982) and Bouvet Island (Thiele and Jaeckel, 1931; Linse, 2006); from 60 m (Hain, 1990) to 1426 m (new record).

Cuspidaria minima (Egorova, 1993) (Fig. 116)

Subcuspidaria minima Egorova, 1993: 164, pl. 3, figs. 2-3.
Cuspidaria minima: Zelaya and Ituarte, 2005: 173, figs, 16-27.

Material studied: 1 spm. (3.0 x 2.1 mm), PI5; 4 spm. (1.5 x 1.1 - 1.9 x 1.3 mm), PA42; 2 spm. (1.5 x 1.0 - 2.3 x 1.8 mm), PA43; 1 spm. (3.0 x 2.1 mm), LOW.

Remarks: Zelaya and Ituarte (2006) established the differences between the Antarctic species of *Cuspidaria* that share the characteristic of marked lamellae. In this sense, the similar species *C. kerguelenensis* (Smith, 1885) and *C. concentrica*

Thiele, 1912 differ in having less spaced lamellae, the dorsal margin of the rostrum almost concave and a postero-ventral margin which is more concave than in *C. minima*. *Cuspidaria plicata* Thiele, 1912 differs in having no lamellose concentric sculpture.

Distribution: South Orkney (Egorova, 1993) and South Shetland Islands (Zelaya and Ituarte, 2005; this study), Western Antarctic Peninsula, Peter I Island (new records) and Wilkes Land (Egorova, 1993); from 115 to 1272 m (new records).

Genus *Myonera* Dall and Smith, 1886

Myonera fragilissima (Smith, 1885) (Fig. 117)

Naera fragilissima Smith, 1885: 53, pl. 9, figs. 1-1b.
Cuspidaria fragilissima: Pelseneer, 1903: 28.
Myonera fragilissima: Soot-Ryen, 1951: 23; Branch *et al.*, 1991: 51 (key).

Material studied: 1 spm. (broken), MB14; 2 spm. (1.4 x 0.8 - 2.9 x 1.8 mm), PI27.

Distribution: Bellingshausen Sea (Pelseneer, 1903; this study) to Peter I Island (new record), Marion (Branch *et al.*, 1991) and Prince Edward Islands (Smith, 1885), also in Kerguelen Islands (Carcelles, 1953); from 498 to 1873 m (new records).

Class Scaphopoda Bronn, 1862
Order Dentaliida da Costa, 1776
Family Dentaliidae Gray, 1834
Genus *Dentalium* Linné, 1758

Dentalium majorinum Mabille and Rochebrune, 1889 (Fig. 118)

Dentalium majorinum Mabille and Rochebrune, 1889: 100, pl. 4, fig. 10; Plate, 1908b: 1; Smith, 1915: 74; Hedley, 1916: 67, pl. 9, figs. 104-105; Dell, 1964: 123; Arnaud, 1973: 554; Linse, 1997: 42; Steiner and Linse, 2000: 17, figs. 3, 8, 10 (radula); Steiner and Kabat, 2004: 593, 596, 612, 613.
Fissidentalium majorinum: Dell, 1990: 72; Osorio and Reid, 2004: 84, fig. 2f.
Dentalium majorinum var. *magellanicum* Pilsbry and Sharp, 1897: 27, pl. 12, figs. 95-97.
Dentalium magellanicum: Powell, 1958: 207.
Dentalium majorinum var. *gaussianum* Plate, 1908b: 5, figs. 1-4.
Dentalium shoplandi Jousseaume: Melvill and Standen, 1907: 143; Lamy, 1910a: 324; 1911a: 16 (no Jousseaume, 1894).

Material studied: 1 spm. (27.9 x 2.8 x 0.8 mm), MB1; 2 spm. (5.0 x 1.1 x 0.8 - 10.7 x 1.9 x 0.8 mm), MB2; 21 spm. (12.5 x 2.0 x 0.7 - 35.5 x 3.9 x 1.0 mm), PI7; 2 spm. (15.0 x 2.9 x 2.3 - 16.9 x 2.2 x 0.8 mm), PI8; 51 spm. (8.9 x 1.8 x 0.7 - 31.8 x 2.6 x 0.7 mm), MB9; 1 spm. (26.1 x 3.0 x 0.8 mm), MB10; 2 spm. (10.0 x 1.4 x 0.8 - 19.8 x 2.0 x 0.8); MB11; 18 spm. (11.4 x 1.4 x 0.5 - 36.5 x 3.8 x 1.0 mm), MB13; 5 spm. (13.6 x 1.6 x 0.5 - 24.0 x 2.7 x 1.0 mm), MB14; 2 spm. (12.0 x 1.7 x 0.8 - 12.1 x 1.8 x 0.8 mm), PA19; 1 spm. (16.1 x 3.0 x 1.7 mm), MB26; 1 spm. (16.0 x 3.0 x 1.5 mm), MB30; 2 spm. (7.2 x 1.0 x 0.4 - 12.8 x 1.8 x 0.8 mm), MB31; 1 spm. (23.7 x 3.7 x 1.4 mm), MB32; 1 spm. (20.6 x 2.5 x 0.7 mm), MB33; 2 spm. (5.8 x 1.7 x 1.1 - 7.0 x 1.8 x 1.2 mm), MB34; 4 spm. (8.2 x 3.0 x 2.6 - 12.1 x 1.8 x 0.8 mm), MB35; 27 spm. (13.5 x 1.8 x 0,8 - 25.5 x 2.2 x 0.6 mm), MB36; 4 spm. (9.2 x 1.5 x 0.7 - 15.6 x 3.0 x 1.8 mm), MB37; 9 spm. (6.3 x 1.3 x 0.8 - 20.3 x 2.0 x 0,7 mm), MB38; 2 spm. (26.1 x 3.6 x 0.7 - 27.1 x 3.2 x 0.7 mm), PA39.

Remarks: Steiner and Linse (2000) revised the group in the Magellanic Region and validated the synonyms, including *Dentalium majorinum gra-*

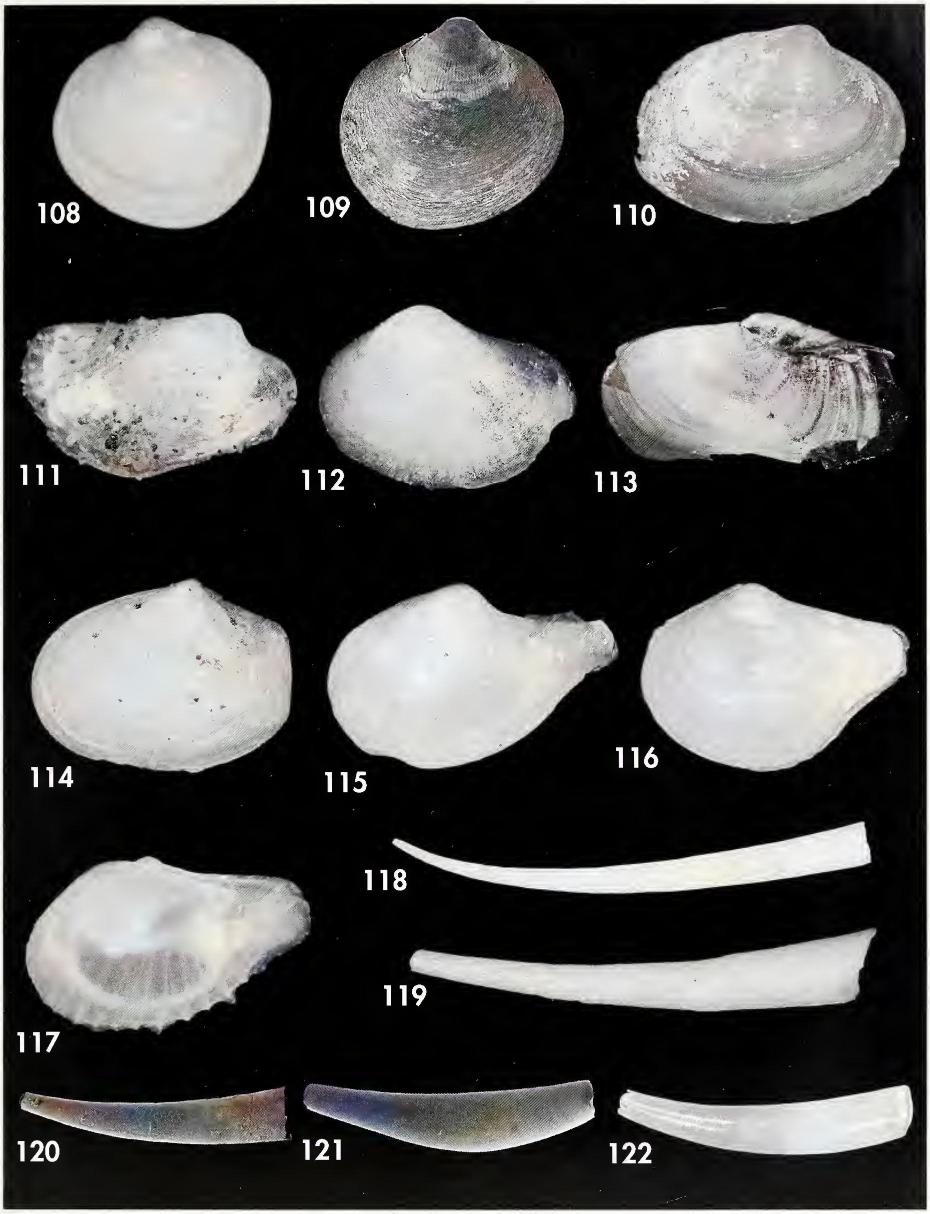

Figure 108. *Pseudokellya cardiformis*, 4.1 x 4.1 mm, PA21. Figure 109. *Cyamiocardium denticulatum*, 4.3 x 4.2 mm, PI8. Figure 110. *Cyamiomactra laminifera*, 6.3 x 5.0 mm, PA20. Figure 111. *Lyonsia arcaeformis*, 7.1 x 4.2 mm, DEC. Figure 112. *Poromya adelaidis*, 28.1 x 19.8 mm, LOW. Figure 113. *Laternula elliptica*, 33.0 x 18.0 mm, PI5. Figure 114. *Thracia meridionalis*, 8.1 x 6.0 mm, PA21. Figure 115. *Cuspidaria infelix*, 12.7 x 7.8 mm, PA21. Figure 116. *Cuspidaria minima*, 3.0 x 2.1 mm, PI5. Figure 117. *Myonera fragilissima*, 2.9 x 1.8 mm, PI27. Figure 118. *Dentalium majorinum*, 23.2 x 2.0 x 0.6 mm, MB9. Figure 119. *Rhabdus* cf. *perceptus*, 26.0 x 3.9 x 1.3 mm, MB17. Figure 120. *Striopulsellum minimum*, 3.4 x 0.6 x 0.3 mm, PI28. Figure 121. *Cadulus thielei*, 4.0 x 0.7 x 0.4 mm, MB33. Figure 122. *Siphonodentalium dalli*, 14.2 x 2.6 x 1.3 mm, PI7.
Figuras 108-122. Ver los nombres científicos en el rótulo en inglés.

hamense Odhner, 1931. Steiner and Kabat (2004) gave a complete list of synonyms of this species.

Distribution: Weddell Sea (Melvill and Standen, 1907; Dell, 1990), Falkland/Malvinas Islands (Dell, 1990), Cape Horn (Mabille and Rochebrune, 1889), Beagle Channel (Linse, 1997), Magellan Strait and Tierra del Fuego Island (Dell, 1990), reaching the South Pacific coast (44° S - 45° S, South Chile) (Osorio and Reid, 2004), South Shetland Islands (Dell, 1990), Western Antarctic Peninsula (Lamy, 1911a; Odhner 1931 in Powell, 1960; Dell, 1990; this study), Bellingshausen Sea (Lamy, 1911a; Dell, 1990; this study) to off Thurston Island and Peter I Island (new records), Ross Sea and Balleny Islands (Dell, 1990), 163° E (Smith, 1915), Terre Adélie to Wilkes Land (Hedley, 1916; Powell, 1958), Shackleton Ice Shelf (Hedley, 1916; Dell, 1990), Davis Sea (Plate, 1908b; Powell, 1958) and from Amery Ice Shelf to Enderby (Powell, 1958); from 24 m (Dell, 1990) to 2579 m (Melvill and Standen, 1907).

Family Rhabdidae Chistikov, 1975
Genus *Rhabdus* Pilsbry and Sharp, 1897

Rhabdus cf. *perceptus* (Mabille and Rochebrune, 1889) (Fig. 119)

Dentalium perceptum Mabille and Rochebrune, 1889: 99; Dell, 1964: 124; Linse, 1997: 42.
Rhabdus perceptum: Steiner and Linse, 2000: 18, fig. 4, 11, 13 (radula); Osorio and Reid, 2004: 84, fig. 2g.
Rhabdus perceptus: Steiner and Kabat, 2004: 628.

Material studied: 1 sh. (30.1 x 3.7 x 2.1 mm), PI7; 2 spm. (42.5 x 4.5 x 1.0 - 43.2 x 4.7 x 1.1 mm), MB12; 1 spm. and 1 sh. (18.7 x 5.0 x 3.9 - 26.0 x 3.9 x 1.3 mm), MB17; 7 spm. (6.8 x 1.3 x 0.8 - 45.8 x 5.8 x 1.2 mm), MB26; 9 spm. (18.5 x 3.0 x 1.3 - 41.4 x 4.5 x 1.3 mm), MB30; 22 spm. (26.1 x 3.0 x 1.0 - 49.8 x 5.8 x 1.1 mm), MB32.

Remarks: The individuals studied in BENTART expeditions were conferred to this species, because they are thicker than that used for the original description and than those from Steiner and Linse (2000), also they are out of the distributional range.

Distribution: Cape Horn (Mabille and Rochebrune, 1889), Beagle Channel (Linse, 1997), reaching 41° S in the South Pacific coast (Cárdenas *et al.*, in press); from 80 to 993 m (Cárdenas *et al.*, in press).

Order Gadilida Starobogatov, 1974
Family Pulsellidae Scarabino in Boss, 1982
Genus *Striopulsellum* Scarabino, 1995

Striopulsellum minimum (Plate, 1908) (Fig. 120)

Siphonodentalium minimum Plate, 1908b: 4, fig. 5; Dell, 1990: 74.
Striopulsellum minimum: Steiner and Kabat, 2004: 617.

Material studied: 37 spm. (2.1 x 0.4 x 0.1 - 4.7 x 0.9 x 0.4 mm), PI27; 3 spm. (3.3 x 0.8 x 0.2 - 4.0 x 0.9 x 0.3 mm), PI28; 11 spm. (1.8 x 0.4 x 0,2 - 4.9 x 0.8 x 0.3 mm), MB33; 4 spm. (2.8 x 0.6 x 0.1 - 4.0 x 0.7 x 0.2 mm), MB34; 6 spm. (2.0 x 0.2 x 0.1 - 3.5 x 0.5 x 0.1 mm), MB35; 23 spm. (3.0 x 0.6 x 0.1 - 5.0 x 0.7 x 0.2 mm), MB36; 3 spm. (4.0 x 0.7 x 0.3 - 4.1 x 0.7 x 0.3 mm), MB38.

Distribution: Bellingshausen Sea and Peter I Island (new records), Ross Sea (Dell, 1990) and Davis Sea (Plate, 1908b), also in New Caledonia (Scara-

bino 1995 in Steiner and Kabat, 2004); from 238 m (Dell, 1990) to 6179 m (Scarabino 1995 in Steiner and Kabat, 2004).

Family Gadilidae Stoliczka, 1868
Genus *Cadulus* Philippi, 1844
Cadulus thielei Plate, 1908 (Fig. 121)

Cadulus thielei Plate, 1908b: 3, figs. 6-11; Dell, 1990: 73, figs. 120-121; Steiner and Kabat, 2004: 656.

Material studied: 1 spm. (4.0 x 0.7 x 0.4 mm), MB33; 1 spm. (3.9 x 0.5 x 0.3 mm), PA39.

Distribution: Western Antarctic Peninsula and Bellingshausen Sea (new records), Ross Sea (Dell, 1990) and Davis Sea (Plate, 1908b); from 157 to 438 m (new records).

Genus *Siphonodentalium* Sars, 1859
Siphonodentalium dalli (Pilsbry and Sharp, 1898) (Fig. 122)

Cadulus dalli Pilsbry and Sharp, 1898: 155, pl. 30, figs. 19-23; Plate, 1908b: 4, fig. 12; Powell, 1958: 207.
Siphonodentalium dalli: Steiner and Linse, 2000: 21; Steiner and Kabat, 2004: 581.
Siphonodentalium dalli f. *dalli*: Steiner and Linse, 2000: 21, figs. 6, 15 (radula).
Cadulus dalli var. *antarcticus* Odhner, 1931: 5, pl. 1, figs. 5-7, 9, 11, 13-14, pl. 2, figs. 18-21, 24-25.
Cadulus dalli antarcticus: Dell, 1964: 130; Dell, 1990: 73, figs. 118-119.
Siphonodentalium dalli f. *antarcticus*: Steiner and Linse, 2000: 23, figs. 7, 14, 16 (radula); Steiner and Kabat, 2004: 563 (synonymy).

Material studied: 12 spm. (7.8 x 1.9 x 0.7 - 20.1 x 3.1 x 1.7 mm), PI5; 52 spm. (4.9 x 1.1 x 0.4 - 16.1 x 2.6 x 1.3 mm), PI6; 1 spm. (14.2 x 2.6 x 1.3 mm), PI7; 5 spm. (11.0 x 2.4 x 1.7 - 18.3 x 3.2 x 2.0 mm), PA24; 1 spm. (10.0 x 1.3 x 0.8 mm), MB36.

Remarks: Steiner and Linse (2000) studied the differences between the samples from the Beagle Channel (named *Siphonodentalium dalli* f. *dalli* (Pisbry and Sharp, 1898)) and from Antarctica (named *Siphonodentalium dalli* f. *antarcticus* Odhner, 1931) and they concluded that in spite of significative differences of morphometric characters found in statistical tests, more data are necessary in order to consider them as two subspecies.

Distribution: South Pacific Ocean (51° S, 74° W) (Pilsbry and Sharp, 1898), Magellan Strait (Plate, 1908b) and Beagle Channel (Steiner and Linse, 2000), South Orkney and South Shetland Islands (Dell, 1990), Western Antarctic Peninsula (Odhner, 1931; Dell, 1990; this study), Bellingshausen Sea (Dell, 1990; this study) and Peter I Island (new record), Ross Sea, Shackleton Ice Shelf and Davis Sea (Dell, 1990), and from the Amery Ice Shelf to the Enderby Land (Powell, 1958); from 93 m (Dell, 1990) to 1056 m (new record).

CONCLUSIONS

A total of 3133 individuals belonging to 118 species of molluscs were identified. Seventy-one of these species are gastropods with a total of 571 individuals, forty-two species are bivalves with a total of 2200 individuals and five species are scaphopods, with a total of 362 individuals. Among the gastropods, the most abundant species were *Neobuccinum eatoni* with 89 individuals, fol-

lowed by *Philine alata* with 88 individuals. Among bivalves, *Genaxinus debilis* with 674 individuals, followed by *Cyamiocardium denticulatum* with 460 individuals, were the most abundant species. Among the scaphopods *Dentalium majorinum* accounted for most individuals with 159.

Of the total cited species, six new records are added for the South Shetland Islands (*Margarella refulgens, Torellia insignis, Antarctodomus thielei, Notoficula bouveti, Limopsis enderbyensis* and *Thyasira bongraini*), 30 for the Western Antarctic Peninsula (*Puncturella spirigera, Margarella refulgens, Cirsonella extrema, Dickdellia labioflecta, Onoba gelida, Powellisetia deserta, Torellia mirabilis, Torellia planispira, Marseniopsis conica, Pseudamauropsis anderssoni, Pseudamauropsis aureolutea, Acirsa antarctica, Hemiaclis incolorata, Melanella antarctica, Cerithiopsilla antarctica, Cerithiopsilla austrina, Trophon coulmanensis coulmanensis, Pareuthria regulus, Prosipho reversus, Prosipho turritus, Belaturricula gaini, Conorbela antarctica, Newnesia antarctica, Yoldiella profundorum, Dacrydium albidum, Cyclochlamys gaussianus, Mysella antarctica, Poromya adelaidis, Cuspidaria minima* and *Cadulus thielei*), 34 for the Bellingshausen Sea (*Anatoma euglypta, Cornisepta antarctica, Antimargarita smithiana, Calliotropis antarctica, Solariella antarctica, Liotella endeavourensis, Leptocollonia innocens, Onoba gelida, Pseudamauropsis aureolutea, Falsilunatia delicatula, Acirsa antarctica, Melanella antarctica, Trophon drygalskii, Chlanidota signeyana, Lusitromina abyssorum, Belaturricula ergata, Conorbela antarctica, Leucosyrinx paratenoceras, Typhlomangelia principalis, Acteon antarcticus, Neactaeonina edentula, Yoldiella antarctica, Yoldiella profundorum, Yoldiella sabrina, Limatula hodgsoni, Limatula simillima, Cyclopecten notalis, Cyclopecten pteriola, Cyclocardia astartoides, Mysella gibbosa, Cyamiocardium denticulatum, Cuspidaria infelix, Striopulsellum minimum* and *Cadulus thielei*) and 30 for Peter I Island (*Margarella refulgens, Onoba gelida, Onoba kergueleni, Onoba turqueti, Marseniopsis mollis, Marseniopsis syowaensis, Pseudamauropsis anderssoni, Pseudamauropsis aureolutea, Falsilunatia delicatula, Melanella antarctica, Trophon cuspidarioides, Trophon longstaffi, Chlanidota signeyana, Pareuthria regulus, Prosipho chordatus, Prosipho hedleyi, Prosipho pellitus, Prosipho pusillus, Typhlodaphne innocentia, Neactaeonina edentula, Philine alata, Yoldiella antarctica, Yoldiella profundorum, Cyclopecten notalis, Genaxinus debilis, Cuspidaria minima, Myonera fragilissima, Dentalium majorinum, Striopulsellum minimum* and *Siphonodentalium dalli*).

On the other hand, new bathymetric records are given for 44 species (*Antimargarita smithiana, Calliotropis pelseneeri, Solariella antarctica, Tropidomarga biangulata, Liotella endeavourensis, Onoba gelida, Torellia planispira, Marseniopsis syowaensis, Pseudamauropsis aureolutea, Acirsa antarctica, Hemiaclis incolorata, Melanella antarctica, Trophon drygalskii, Trophon echinolamellatus, Lusitromina abyssorum, Notoficula bouveti, Prosipho chordatus, Prosipho pellitus, Prosipho pusillus, Prosipho reversus, Belaturricula gaini, Aforia multispiralis, Typhlodaphne innocentia, Typhlomangelia principalis, Acteon antarcticus, Nucula austrobenthalis, Yoldiella antarctica, Yoldiella profundorum, Yoldiella sabrina, Bathyarca sinuata, Limopsis enderbeyensis, Limatula hodgsoni, Limatula simillima, Cyclochlamys gaussianus, Cyclopecten notalis, Cyclopecten pteriola, Genaxinus debilis, Mysella antarctica, Cyamiocardium denticulatum, Cuspidaria infelix, Cuspidaria minima, Myonera fragilissima, Cadulus thielei* and *Siphonodentalium dalli*).

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A new raphitomine neogastropod from the Mediterranean Sea (Conoidea)

Una nueva especie de *Raphitoma* (Conoidea) del mar Mediterráneo

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ABSTRACT

Raphitoma villaria n. sp. is described from Taormina (Sicily) and is compared with the closely related *R. leufroyi* (Michaud, 1828). Differential characters are given for the protoconch, the adult shell, and the colour pattern of the living animal. *Raphitoma villaria* n. sp. lacks a radula which is present in *R. leufroyi*. The new species has been confused with *R. erronea* (Monterosato, 1884), which is a different species.

RESUMEN

Se describe *Raphitoma villaria* n. sp. de Taormina (Sicilia) y se compara con la especie estrechamente emparentada *R. leufroyi* (Michaud, 1828). Se indican caracteres diferenciales relativos a la protoconcha y al patrón de color del animal vivo. *Raphitoma villaria* n. sp. carece de radula, la cual está presente en *R. leufroyi*. La especie nueva se ha confundido con *R. erronea* (Monterosato, 1884), que es una especie distinta.

KEY WORDS: Gastropoda, Mediterrenean Sea, new species, *Raphitoma*.
PALABRAS CLAVE: Gastropoda, mar Mediterráneo, nueva especie, *Raphitoma*.

INTRODUCTION

The Mediterranean species of the subfamily Raphitominae are currently being revised by Pusateri, Giannuzzi-Savelli, Spada and Oliverio. Prior to the main revision, we present here the description of a new species that can be confused (and actually has been) with *Pleurotoma volutella* Kiener, 1846.

KIENER (1846: 67) described *P. volutella* as recent from Sicily, yet it is known that sometimes he reported fossil species as living [S. Palazzi, pers. comm.]. In fact, *Pleurotoma volutella* is relatively well known from the Plio-Pleistocene (SEGUENZA, 1880; DE LAMOTHE AND DAUTZENBERG 1908; CERULLI-IRELLI, 1910; HARMER, 1915; ALBERICI AND TAMINI, 1935; COMPAGNONI, CONATO, FOLLIERI AND MALATESTA, 1969). No recent specimens have been found by the authors during the present revision, despite the examination of over 200 lots of raphitomines of the *R. leufroyi* (Michaud, 1828) group. All recent records in the literature are either secondary references derived from Kiener's original error (CARUS, 1893; PIANI, 1980; SABELLI, GIANNUZZI-SAVELLI, AND BEDULLI, 1990) or erroneous identifications of particular morphotypes of

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Raphitoma leufroyi (e.g.: Philippi, 1844; Aradas and Benoit, 1876; Monterosato, 1878; Priolo 1967). Unfortunately, the types of *P. volutella* have not been found, despite search in the Delessert collection (Y. Finet, Geneve, pers. com.), in the MNHN collections, and in other European museums.

In the Monterosato collection (ZMR) there are two specimens labelled "*Defrancia volutella*, Palermo" and "*Leufroya volutella*, fossile di Ficarazzi", respectively (Figs. 19, 20).

In the Melvill-Tomlin collection (NMW, 12930) there is a specimen (Fig. 21) labelled by Monterosato "*Leufroya volutella* Kiener, fossile di Ficarazzi, non vivente". A second handwritten label reads: "Kiener a cru vivant un specimen ramassé par la mer". All these specimens fit perfectly the original figure by Kiener, and are congruent with the usual interpretation of *Pleurotoma volutella*, as a fossil.

A recent species, included in the genus *Raphitoma*, has possibly been confused in collections under the name *Leufroya volutella*. It is a different unnamed species that is herein described as new.

RESULTS

Raphitoma villaria n. sp.

Pleurotoma (Defrancia) volutella sensu Tiberi in schedis non Kiener, 1846 (Swedish Mus. Nat. Hist. n. 70490)
Leufroya volutella sensu AA. non Kiener, 1846
Raphitoma (Leufroya) erronea sensu Mifsud, 2003 non Monterosato, 1884
? *Raphitoma leufroyi* sensu Rolán et al., 1998 non Michaud, 1832

Type material: Holotype (MNHN, Paris: Figs. 1-3), height 17.3 mm, width 6.8 mm, from Taormina, -15 m, bioclastic sediment (A. Villari leg.). Paratype A (Figs 4, 6, 8; MNHN, Paris, C. Mifsud, leg., ex Gubbioli collection; height 11.5 mm, width 4.6 mm), from Malta, off Ras il-Wahx, –80/100 m, muddy sand with *Posidonia* debris. Paratype B (C. Mifsud coll., Malta; height 14.4 mm, width 5.6 mm), from Malta, off Ras il-Wahx. Paratype C (Fig. 10; Gori coll., Livorno; height 16.9 mm, width 6.5 mm), from Capraia Is., -150 m. Paratype D (Figs 11, 12; F. Pusateri coll., Palermo; height 12 mm, width 4.8 mm, juvenile), from Bay of Carini (Palermo), coralligenous bottoms. Paratype E (Bini coll., Città di Castello; height 8.6 mm, width 3.9 mm, juvenile), from Antiparos Is. (Cyclades), -180/250 m. Paratype F (SMNH, Stockholm, n. 70490; ex N. Tiberi, labelled *Pleurotoma (Defrancia) volutella*; height 9.3 mm, width 4.7 mm, juvenile), from Sardinia, coralligenous bottom.
Other material examined: 18 shells from Gnejna Bay (Malta), 80/100 m; 5 shells from Qammich reef (Malta), -80 m; 1 shell from Misurata (Lybia), -60/80 m. (all in the C. Mifsud collection).
Type locality: Taormina, eastern Sicily, -15 m, bioclastic sediment.
Derivatio nominis: After our dear friend Alberto Villari (Villari+A(lberto) = *villaria*) used as a noun in apposition.

Description: Shell slender, fusiform, 15-18 mm high and 6-7 mm wide.

Protoconch multispiral, of 3.25 whorls. Protoconch I of 1.2, dome shaped whorls, with a sculpture of 8-9 spiral threads, covered by minute tubercles; tubercles tending to become oblong and anastomosing, giving rise to a somewhat clathrate pattern. Protoconch II of slightly more than 2 convex whorls, with a sculpture of only subsutural axial threads on the adapical third, tending to curve adaperturally. On the lower two thirds sculpture of diagonally crossing threads. Sinusigera outer lip at the protoconch-teleoconch boundary.

Teleoconch of 6-7 whorls, with stepped spire. Subsutural ramp narrow, suborizontal, tending to obliterate after the sixth whorl. Adsutural marks of the anal sinus visible on the ramp. Axial sculpture of 15-18 ribs, narrower than the interspaces, reaching the base.

Figures 1-3. *Raphitoma villaria* n. sp. Holotype (MNHN, Paris, h. 17.3 mm, w. 6.8 mm), Taormina -15 m.
Figuras 1-3. Raphitoma villaria *n. sp. Holotipo (MNHN, Paris, h. 17,3 mm, d. 6,8 mm), Taormina - 15 m.*

Spiral sculpture of numerous continuous cordlets, 13-16 above the aperture, regularly spaced, on the body whorl; 10-12 strong cords on the siphonal canal.

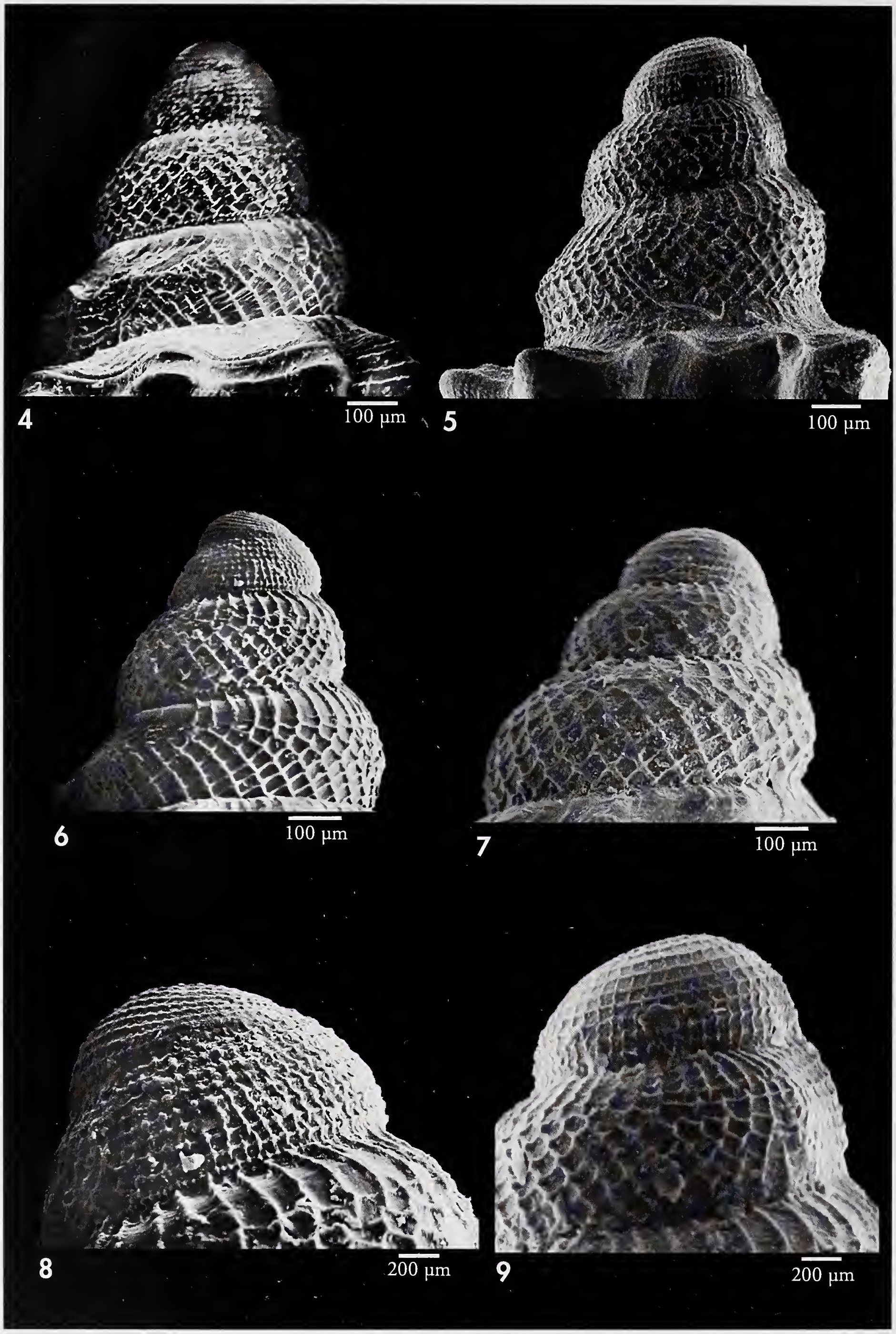
Aperture suboval, tapering anteriorly. Outer lip simple, internally smooth. Anal sinus as deep as the interspace between two axial ribs. Inner lip smooth, arcuate posteriorly, straigth medially. Siphonal canal short, open.

Background colour yellowish with a lighter narrow band on the lower third of the spire. The spiral cordlets within this band may be sligthly stronger that the others.

Animal with a short head and two short tentacles. Eyes placed on the external, thickened basal part of the tentacles, at about one third of their total height. Foot narrow and long with two anterior lateral triangular lobes and a pointed posterior end. Colour light yellow with a lighter coloured foot, darker tentacles and black eyes. Siphon much darker (nearly orange) in colour. Operculum absent.

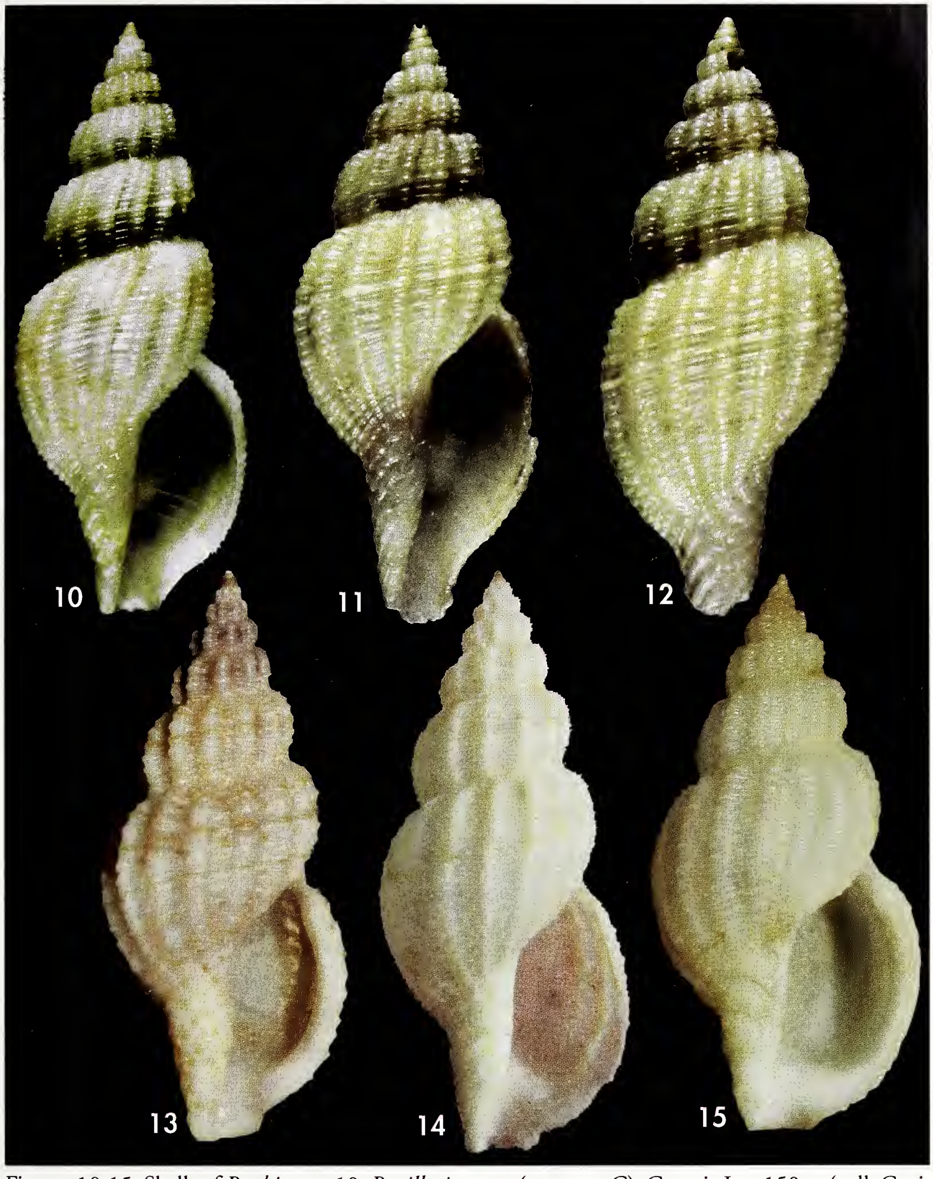
Distribution: Known from the type locality (Taormina, eastern Sicily) and from Malta, Bay of Carini (northwestern Sicily), Capraia Is. (Northern Tyrrhenian Sea). ROLÁN, OTERO-SCHMITT AND FERNANDES (1998: 108, figs 26-28) reported a shell from Angola extremely similar to the new species. Considering the lack of additional data on the extra-Mediterranean occurrence of *R. villaria* n. sp. we cannot confirm the identity of the Angolan material. It could represent a sibling species, or the extreme southern range of the new species.

Remarks: The foregut anatomy of a specimen of this species (under the name "*Caenodagreutes erronea*") was examined and described by Don



Figures 4-9. Protoconchs of *Raphitoma*. 4, 6, 8: *R. villaria* n. sp. (paratype A); 5, 7, 9: *R. leufroyi*, specimen from Palermo (coll. Pusateri).

Figurs 4-9. Protoconchas de Raphitoma. *4, 6, 8:* R. villaria *n. sp. (paratipo A); 5, 7, 9:* R. leufroyi, *ejemplar de Palermo (coll. Pusateri).*



Figures 10-15. Shells of *Raphitoma*. 10: *R. villaria* n. sp. (paratype C), Capraia Is., -150 m (coll. Gori, Livorno, h. 16.9 mm, w. 6.5 mm); 11, 12: *R. villaria* n. sp. (paratype D), Bay of Carini, Palermo, (subadult, coll. Pusateri, Palermo, h. 12 mm, w. 4.8 mm); 13: *R. concinna,* Termini Imerese (Palermo), muddy sand (coll. Pusateri, Palermo, h. 13.8 mm); 14: *R. leufroyi* ("var. *albescens*"), Palermo, coll. Monterosato (MZR, Rome); 15: *Defrancia erronea* Monterosato, 1884. mm 22 x 16, holotype, handwritten label by Monterosato: "*D. volutella Sardegna tipo di erronea*" (MZR lot n. 16704).
Figuras 10-15. Conchas de Raphitoma. *10:* R. villaria *n. sp. (paratipo C), Isla de Capraia, -150 m (coll. Gori, Livorno, h. 16,9 mm, d. 6,5 mm); 11, 12:* R. villaria *n. sp. (paratipo D), Bahía de Carini, Palermo, (subadulto, coll. Pusateri, Palermo, h. 12 mm, d. 4,8 mm); 13:* R. concinna, *Termini Imerese (Palermo), arena fangosa (coll. Pusateri, Palermo, h. 13,8 mm); 14:* R. leufroyi *("var. albescens"), Palermo, coll. Monterosato (MZR, Roma); 15:* Defrancia erronea *Monterosato, 1884. mm 22 x 16, holotipo, etiqueta manuscrita de Monterosato:* "D. volutella Sardegna tipo di erronea" *(MZR lot n. 16704).*

Tippett (*in litteris*, 2001). The specimen (15.5 mm long and 6.1 mm wide, protoconch tip missing, 1.5 protoconch whorls remaining, diagonally cancellate) originated from Malta, Qummick, 80 m depth (vi. 1988, C. Mifsud leg.). The specimen lacked a proboscis, poison apparatus, radula and salivary glands. The rhynchodaeum was very retracted and folded, with the posterior end bearing a tiny circular opening into the oesophagus.

Pending a phylogenetic assessment of the Raphitominae, we ascribe the new species to the genus *Raphitoma* Bellardi 1848 (type species, by subsequent designation [Monterosato, 1875]: *Pleurotoma hystrix* Cristofori and Jan, 1832).

A group of species with the aperture internally smooth, without either teeth or lyrae is commonly included in the subgenus *Leufroya* Monterosato, 1884 (type species by tautonymy *Pleurotoma leufroyi* Michaud, 1828): *Raphitoma leufroyi* (Michaud, 1828), *R. concinna* (Scacchi, 1836), *R. erronea* (Monterosato, 1884), *R. linearis* (Montagu, 1803), *R. aequalis* (Jeffreys, 1867). The new species belongs clearly in this group, being very similar to *R. leufroyi*. Comparing two mature specimens of each species, the protoconch is smaller in *leufroyi* (450 μm vs 600 μm) and generally brown in colour (vs. yellowish in *villaria*). The subsutural ramp is absent in *leufroyi*; the h/d ratio is higher in *villaria* (h/d > 2.5 vs < 2.2 in *leufroyi*). The spiral cordlets (16 in *villaria* vs 12 in *leufroyi*) are all of the same size in *villaria* vs. of alternate size in *leufroyi*. The outer lip is thickened in *leufroyi* vs. simple in *villaria*.

The background colour is lighter with brownish spots in *leufroyi* and uniformly yellowish in *villaria*. The animal of *leufroyi* is pure white, with light blue blurs on the end of the foot. The eyes are larger in *leufroyi* and are placed halfway up the tentacles. The foot is wider in *leufroyi*. The radula is present in *leufroyi* and absent in *villaria*. Even in some occasional ligthly coloured specimens of *leufroyi* the remaining differences hold diagnostic.

This species has been confused in several collections with *R. erronea* (Monterosato, 1884), which is completely different, having more numerous spiral cordlets, a shorter siphonal canal, a more rounded aperture, and a h/d ratio of 1.25 (vs. 2.5 in *villaria*).

R. volutella (see figs 18-21) has a more stepped outline, and a longer siphonal canal, axial and spiral sculpture are stronger.

R. concinna is smaller (<15 mm), and the axial ribs are always $\leq$ 14 (vs. 15 in *villaria*). The axial interspaces and ribs are of equal size (interspaces wider in *villaria*). *R. villaria* has more numerous and weaker spiral cordlets , and lacks the typical brown cordlets of *concinna*. Finally, the protoconch of *R. concinna* is violet while it is always yellowish in *villaria*.

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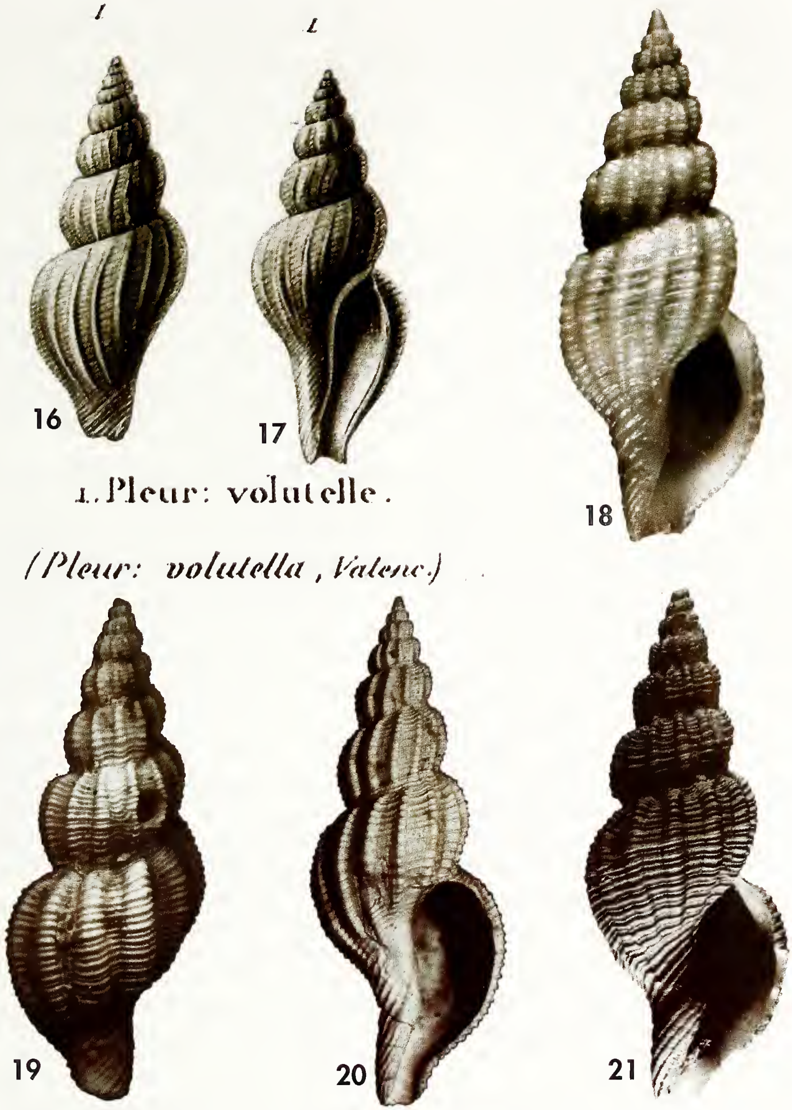
Philippe Bouchet, Virginie Heros and Pierre Lozouet (MNHN, Paris) kindly assisted during our visits to the "Labo". Claudio Manicastri (ZMR, Rome) allowed examination of the material in the Monterosato Collection. Anders Warén (SMNH, Stockholm) and Harriet Wood (National Museum of Wales) provided useful material for study, and Yves Finet (MHNG, Geneve) for information on Kiener types.

C. Mifsud provided the data on the living animals of *R. villaria* n. sp. and *R.*



Figures 16-21. Shells of *Raphitoma villaria* n.sp. and *Pleurotoma volutella.* 16, 17: Original figure of *Pleurotoma volutella* (after Kiener, 1846, photo courtesy Virginie Heros, MNHN Paris); 18: *Raphitoma villaria* n. sp., paratype A, off Ras il-Wahx, Malta, (ex Gubbioli collection), h 11.5 mm, d 4.6 mm; 19, 20: *P. volutella*, Palermo (Coll. Monterosato, MZR, Rome, lote n. 16704, "*Defrancia volutella*"); 21*:* *P. volutella*, Ficarazzi, coll. Melvill-Tomlin (NMW, 12930) with Monterosato's handwritten label ["*Leufroyia volutella* Kiener", fossile di Ficarazzi, non vivente]. A second handwritten label (also by Monts.) reads: "Kiener a cru vivant un specimen ramassé par la mer".

Figuras 16-21. Conchas de *Raphitoma villaria* n.sp. y *Raphitoma volutella.* 16, 17: Figura original de *Pleurotoma volutella* (reproducido de Kiener, 1846, fotografía de Virginie Heros, MNHN Paris); 18: *Raphitoma villaria* n. sp., paratipo A, frente a Ras il-Wahx, Malta, (colección Gubbioli), h 11,5 mm, d 4,6 mm; 19, 20: *P. volutella*, Palermo (Coll. Monterosato, MZR, Roma, lote nº 16704, "*Defrancia volutella*"); 21*:* *P. volutella*, Ficarazzi, coll. Melvill-Tomlin (NMW, 12930) con etiqueta manuscrita de Monterosato ["*Leufroyia volutella* Kiener", fossile di Ficarazzi, non vivente]. Una segunda etiqueta manuscrita (también de Monts.) reza: "Kiener a cru vivant un specimen ramassé par la mer".

leufroyi, while Javier López sent a picture of the animal of *L. leufroyi*. SEM photographs were taken by Anna Maria Mannino and Francesco Furnari (Dipartimento di Scienze Botaniche, University of Palermo). Digitalization of images was by Floriana Giannuzzi-Savelli.

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New data on the morphology and distribution of *Euglandina obtusa* (Pfeiffer, 1844) Gastropoda: Spiraxidae) a Nicaraguan endemism

Nuevos datos sobre la morfología y la distribución de *Euglandina obtusa* (Pfeiffer, 1844) (Gastropoda: Spiraxidae) un endemismo de Nicaragua

Mijail A. PÉREZ*, Kepa ALTONAGA** and Adolfo LÓPEZ***

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ABSTRACT

Aspects related to the morphology and distribution of *Euglandina obtusa* (Pfeiffer, 1844) a Nicaraguan endemism are presented. Regarding morphology, a complete redescription of the shell and the first description of the genital system are included. The number of records has been increased, from one, the type locality, to 16. Current data have allowed us to draw a distribution map of the species in Nicaragua.

RESUMEN

Se presentan aspectos relacionados con la morfología y la distribución de *Euglandina obtusa* (Pfeiffer, 1844) un endemismo de Nicaragua. En relación con la morfología, se presenta una redescripción de la concha y la primera descripción del aparato genital. El número de registros de la especie en el país ha sido incrementado de una a 16 localidades. Las cifras anteriores nos han permitido elaborar un mapa preliminar de distribución para la especie en Nicaragua.

KEY WORDS: New data, *Euglandina obtusa*, Gastropoda, Spiraxidae, Nicaragua, Endemism.
PALABRAS CLAVE: Nuevos datos, *Euglandina obtusa*, Gastropoda, Spiraxidae, Nicaragua, Endemismo.

INTRODUCTION

According to PILSBRY (1908), PILSBRY AND VANATTA (1936), BAKER (1945) and THOMPSON (1995), the genus *Euglandina* Fischer and Crosse, 1870 contains 92 species along its distribution range. According to ZILCH (1959-60), the distribution of this genus ranges from southern North America to northern South America, including Central America.

In the Nicaraguan Pacific Slope the genus *Euglandina* is represented by two species: *Euglandina cumingii* (Beck, 1837) and *Euglandina obtusa* (Pfeiffer, 1844). *E. obtusa* is a species endemic to Nicaragua, only known to date from the type locality, Realejo, in the department of Chinadega (UTM 16PDU8286); the only information existing about this

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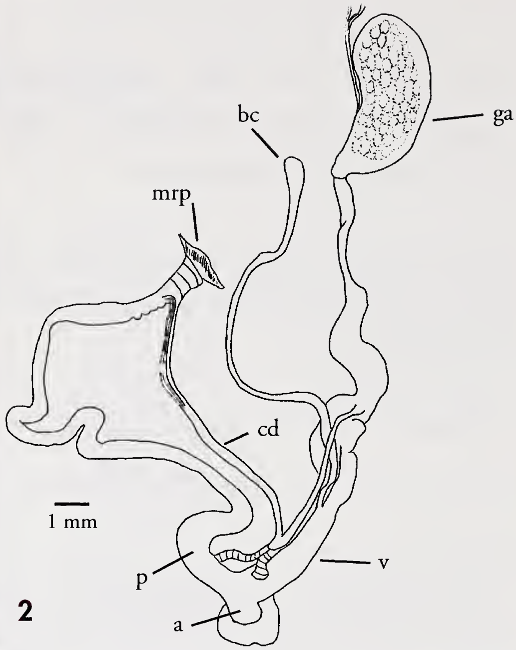

Figure 1. *Euglandina obtusa*. Shell morphology. Cayanlipe, Chinandega, 97:84 (D 11,26 mm, Alt. 27.15 mm). Figure 2. Genital system. Cayanlipe, Chinandega, 97:84 (e= 1 mm).
Figure 1. Euglandina obtusa. *Morfología de la concha. Cayanlipe, Chinandega, 97:84 (D 11.26 mm, Alt. 27.15 mm). Figura 2. Aparato reproductor. Cayanlipe, Chinandega, 97:84 (e= 1 mm).*

taxon so far was a brief description of the shell (PÉREZ, 1999).

The citations for this species in the XIX century literature can be summarized as follows:

Glandina obtusa Pfeiffer, 1844, in Philippi (1842-1845), p. 132, pl. 1 fig. 3.

Achatina obtusa: Reeve (1849 in 1848-1850), Monograph of the genus Achatina pl. 15, species 62.

Achatina obtusa: Deshayes (1850) in Férussac and Deshayes (1819-1851), p. 173, pl. 134 figs. 3, 4.

Oleacina obtusa: Tryon (1885), p. 24, pl. 4 fig. 55

Glandina obtusa: Martens (1891 in 1890-1901), pp. 76-77.

Euglandina obtusa: Pilsbry (1908 in 1907-1908), p. 204.

In this paper we present new data on distribution and morphology for *E. obtusa*. Fifteen new localities are added to the one previously known. Data on shell biometry and the first description of the genital system is also given.

MATERIAL AND METHODS

Source of data: Data presented in this paper have been taken from PÉREZ (1999); this work has been based on gathering, comparison and synthesis of information from two main sources: In the first place, data obtained from revision of bibliography regarding land and freshwater snail species present in Nicaragua and Central America and, secondly, field data obtained from four major sampling campaigns.

Samplings: Sampling campaigns were carried out as follows: 1) December 1994 to March, 1995, 2) August-September, 1996, 3) September-December, 1997 and, 4) July-October, 1998. Fieldwork was done as one-day trips, collect-

Table I. *Euglandina obtusa*. Dimensions. X: Average, DS: Standard Deviation.
Tabla I. Euglandina obtusa. *Dimensiones. X: Promedio, DS: Desviación estándar.*

Variable	X	Minimum	Maximum	Range	DS
Height	24.81	22.2	27.15	4.95	2.19
Diameter	10.5	10.1	11.3	1.2	0.49

Table II. Examined material (52 specimens, 19 live, 33 shells). Dp: department, Coord: coordinates in UTM notation, Ev: animals, C: shells.
Tabla II. Material examinado (52 ejemplares, 19 vivos, 33 conchas). Dp: Departamento, Coord: coordenadas en notación UTM, Ev: ejemplares vivos, C: conchas.

Dp	Lot	Locality	Coordinates	Ev	C
LE	96:40	El Bosque	16PEJ2496	—	1
LE	96:50	3 km al NE de El Empalme	16PEK6504	3	—
LE	96:54	Buenos Aires	16PEJ0169	—	2
LE	96:67	Carretera El Sauce-Estelí	16PEK5432	—	2
CH	97:56	19 de Julio (Paso Caballo)	16PDJ7986	—	1
CH	97:75	El Rincón	16PEK2328	—	1
CH	97:76	Mayocundo	16PEK2515	—	2
CH	97:78	km 194 Chinandega-Somotillo	16PEK1237	—	1
CH	97:81	km 166 Chinandega-Jiquilillo	16PDK5706	—	6
CH	97:82	Tomvalle	16PDK6704	2	—
CH	97:84	Cayanlipe	16PEK0927	—	4
CH	97:85	La Concepción	16PEK3122	—	1
CH	97:86	Las Garzas	16PEK3325	—	3
CH	97:92	Hilocán	16PDK3721	7	2
CH	97:93	Laberinto de San Juan	16PDK3422	7	7

ing at various points each day. A minimum of one point per 10 x 10 km quadrant was sampled, and a maximum of three points. The quantity of points was determined by the punctual species richness; if it was low (below three species) we sampled another point within the same quadrant. There were four persons collecting for an hour at each sampling point.

Collection and conservation of material: Material was hand-collected, kept in plastic boxes and labeled for taking to the lab. Living specimens were relaxed in water with menthol crystals for 24 hours and then stored in 70° alcohol. Once fixed, material was separated, identified and definitively stored in glass vials within glass jars with 70° alcohol, in the case of live-taken specimens, or in glass vials within cardboard boxes, in the case of empty shells.

Abbreviatures: The following abbreviations have been used: B.C.A.: Biologia Centrali Americana, Carr.: Road, e: scale, p./ pp.: page/ s, s.l.p.c.: without an exact locality consigned, RAAN: Región Autónoma del Atlántico Norte, RAAS: Región Autónoma del Atlántico Sur, UCA: Universidad Centroamericana.

RESULTS AND DISCUSSION

Description: Shell cylindrical-fusiform, opaque, solid, glossy (Fig. 1). Spire represents a little less than 1/3 of total shell

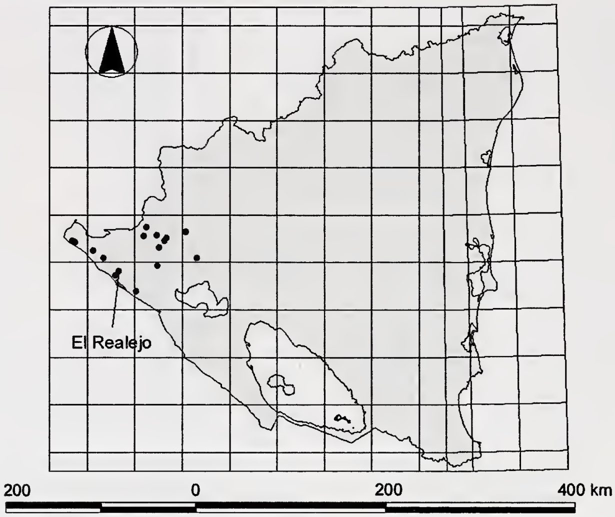

Figure 3. *Euglandina obtusa*. Distribution in Nicaragua, in UTM notation of 50 x 50 km and with mention of the type locality (El Realejo).
Figura 3. Euglandina obtusa. *Distribución en Nicaragua, en notación UTM de 50 x 50 km de lado con mención de la localidad tipo (El Realejo).*

length. Colour brown. Sculpture of fine radial folds. Suture slightly marked. Apex obtuse. Whorls 6, moderately convex. Base imperforate. Aperture long and ovate, placed laterally regarding the shell axis; it represents approximately 1/3 of the body whorl height. Peristome simple and not reflexed. Columella curved and truncated, somewhat thickened. Protoconch of a white to corneous colour, smooth, whorls 1.5.

Dimensions: Alt. 27.15 mm, D. 11. 26 mm (see Table I).

Genital apparatus with a long brawny penis (Fig. 2); retractor muscle wide and short; vas deferens attached to the penis and to the vagina by conjuntive stripes. Vagina short in relation to the penis and as wide as its proximal part. Bursa copulatrix rather small and club-shaped, duct long and thin.

Remarks: MARTENS (1891 in 1890-1901) pointed out that though descriptions and pictures all cite Realejo (also written as Real Llejos) as the locality in which the species was collected, they referred to two different forms, showing differences in size and shape. The smallest one measures between 16 and 19 mm in height and more or less half the width; it was first described by PFEIFFER (1844) in PHILLIPPI (1842-1851), and is the one represented in Pfeiffer´s collection; according to MARTENS (1891), this is the form which he studied. The larger form, measuring 26 to 28 mm and being half as wide as high, is the one depicted by REEVE (1849) and DESHAYES (1850) in FÉRUSSAC AND DESHAYES (1819-1851); this form resembles very much in its dimensions *Euglandina largillierti* Pilsbry, 1891, from Guatemala and Yucatán, but seems to be smoother and brighter.

TRYON (1885) recognized only the dimensions of the larger form (26-28 mm), as relevant to E. obtusa. Later, PILSBRY (1908 in 1907-1908), referred to TRYON´S (1885) description and added that this species seems to link the group of the smooth Central American forms to usual Euglandina.

Our material agrees which what would be the larger "form" mentioned by MARTENS (1891), although with slightly smaller dimensions. Its smooth and lustrous shell sculpture makes the identification of this species very clear.

The genital system of this species is described for the first time in this paper, and as this taxon was known previously only from the type locality, all distribution data given in this paper are new and expand considerably its distribution range.

Distribution: This species was previously cited only from the type locality, but we have added 15 new localities to the one cited in the literature (Fig. 3, Table II). New localities are distributed in two departments (= provinces) (Dpt. of Chinandega and Dept. of León) of northwestern Nicaragua, both within the Nicaraguan Pacific Slope, which suggests a very restricted distribution range. This may be confirmed also by the fact that it has not been collected so far elsewhere in the country over the years.

Along its distribution range E. obtusa was collected on road edges, in dry forests ranging from savannah forests with abundant shrubs to low-medium semideciduous secondary forests. Soil was covered by abundant leaf litter, with or without sand and wet, and illumination was of filtered sun and shade.

It should also be pointed out that *E. obtusa* is a rare species, since lots collected consist only of 1 to 14 specimens.

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Las especies del género *Chauvetia* (Gastropoda, Neogastropoda) del área de Dakar, Senegal, África occidental, con la descripción de diez especies nuevas

The species of the genus *Chauvetia* (Gastropoda, Neogastropoda) from the Dakar area, Senegal, West Africa, with the description of ten new species

Joan Daniel OLIVER* y Emilio ROLÁN**

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RESUMEN

Se revisa el género *Chauvetia* Monterosato, 1884 en el área de Dakar, Senegal. En total se encontraron 14 especies de las que 4 se asignaron a taxones previamente conocidos. Las 10 restantes son especies nuevas para la ciencia que se describen en el presente trabajo. Se muestran fotografías de la concha y detalles de la protoconcha y escultura al Microscopio Electrónico de Barrido.

ABSTRACT

The genus *Chauvetia* Monterosato, 1884 in the area of Dakar, Senegal, is revised. In total 14 species were collected, 4 of which were assigned to previously known taxa. The other ten are new species for science which are described in the present work. Photographs of the shells are presented and details of the protoconchs and sculpture are shown with Scanning Electron Microscope

PALABRAS CLAVE: Buccinidae, *Chauvetia*, protoconcha, microscultura, especies nuevas, Dakar, Senegal.
KEY WORDS: Buccinidae, *Chauvetia*, protoconch, microsculpture, new species, Dakar, Senegal.

INTRODUCCIÓN

El género *Chauvetia* Monterosato, 1884 está formado por un grupo bastante numeroso de especies que se encuentran distribuidas por el Mediterráneo y el Atlántico sureuropeo y norteafricano hasta Senegal, estando también presentes en una parte de los archipiélagos de la Macaronesia. Existen muchos taxones, aunque un cierto número de ellos han sido descritos a nivel de simple variedad.

La mayor parte de las especies que hoy se incluyen en *Chauvetia* han sido descritas en trabajos referidos a una determinada zona o área y están bastante dispersos en la literatura malacológica. NORDSIECK (1976) realizó una primera revisión del género, que fue de nuevo repetida más recientemente por MICALI (1999), aunque refiriéndose fundamentalmente a las especies del Mediterráneo.

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Hay muy poca información sobre algunas particularidades de este género, como sobre su rádula, que sólo ha sido representada por BANDEL (1977, lám. 3, fig. 4), THIELE (1929, fig. 357) y HERGUETA, LUQUE Y TEMPLADO (2002, figs. 9, 10). LUQUE (1984) comenta que los datos sobre las rádulas que se conocen de especies de este género indican que, por su similitud, puede no tener importancia en la separación de especies. Hay también muy pocos datos sobre su opérculo.

Pocos trabajos existen sobre las especies africanas de este género. BRUGUIÈRE (1789) describe la primera especie de la costa africana, dando un nombre disponible a una de las dos especies citadas por ADANSON (1757) en Dakar; MONTEROSATO (1889) describe una nueva especie para Marruecos y el Mediterráneo. DAUTZENBERG (1891) lo hace con otra especie para Senegal, que presenta como variedad de un taxon ya conocido y, posteriormente (DAUTZENBERG, 1910, 1912), menciona varias especies para la costa africana. FISCHER-PIETTE (1942) y FISCHER-PIETTE Y NICKLÉS (1946) comentan algunos taxones de Dakar y *Chauvetia minima* var. *affinis* Monterosato, que también citan en Dakar, y NICKLÈS (1947) también cita 3 especies de esta misma área. NICKLÈS (1950) muestra dibujos de dos de estas especies y KNUDSEN (1956) describe otra especie más para la costa occidental de África.

El presente trabajo pretende revisar el género en el área de Dakar, Senegal, aunque material de otras zonas, como Mauritania o el Mediterráneo, ha sido estudiado como comparación.

Otros trabajos centrados sobre este grupo en algunos archipiélagos de la Macaronesia están actualmente en curso.

MATERIAL Y MÉTODOS

El material ha sido recolectado por el segundo autor en varios viajes a Senegal y se ha visto complementado de forma muy importante por el recogido por otros malacólogos, como Jacques Pelorce, José María Hernández y Franck Boyer, y también por el existente en el MNHN, principalmente colectado por Igor Marche-Marchad en la década de 1950. La recolección se ha efectuado directamente sobre los sedimentos en la arena del intermareal, con snorkel hasta los primeros 10 metros de profundidad y con tanques de aire comprimido, mediante cepillado de piedras, entre 15 y 40 m. También se hicieron algunos dragados entre 20 y 30 m.

Después de la recolección, el material fue examinado con lupa para la observación, en los animales vivientes, de la coloración de las partes blandas. Posteriormente, una parte del mismo se conservó en alcohol.

La protoconcha de las especies de *Chauvetia* tiene una gran importancia en su diferenciación, ya que siendo paucispiral, sus caracteres no están influenciados por el medio; además, se ha comprobado la constancia de los mismos en el examen de numerosos ejemplares de las distintas poblaciones y especies. Por este motivo, hemos tomado determinadas mediciones que se muestran en la Figura 1: diámetro de la protoconcha; diámetro del núcleo; diámetro de la primera media vuelta; altura de la protoconcha. Independientemente, se han estudiado el número de cordoncillos espirales, su microescultura, la relación con sus interespacios, la existencia de costillas axiales, su número, su forma, y su posición.

Abreviaturas

AMNH American Museum of Natural History, New York
BMNH Natural History Museum, London
MNHN Muséum National d'Histoire Naturelle, Paris
MNCN Museo Nacional de Ciencias Naturales, Madrid
USNM United States Natural History, Smithsonian Institution, Washington
MHNS Museo de Historia Natural de Santiago de Compostela (col. Emilio Rolán)

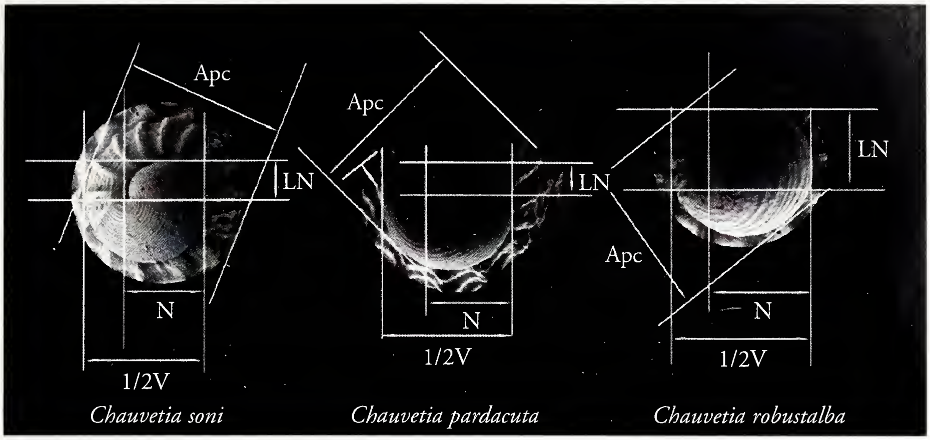


Figura 1. Técnica utilizada en la medición de las protoconchas. N: núcleo. Apc: diámetro de la protoconcha. LN: altura del núcleo. 1/2V: diámetro de la primera media vuelta.
Figure 1. Technique used for measuring protoconchs. N: nucleus. Apc: diameter of the protoconch. LN: height of the nucleus. 1/2V: diameter of the first half-whorl.

ZMUC Zoologisk Museum University, Copenhaguen, Dinamarca
CAP colección de Anselmo Peñas, Vilanova i la Geltrú, Barcelona
CJH colección de José María Hernández, Gáldar, Gran Canaria
CJP colección de Jacques Pelorce, Le Grau du Roi, France
COD colección de Daniel Oliver, Madrid
CPR colección de Peter Ryall, Maria Rain, Austria
ej ejemplar con partes blandas
c concha sin partes blandas
j juvenil
f fragmento

RESULTADOS

Familia BUCCINIDAE
Género *Chauvetia* Monterosato, 1884

Lachesis Risso, 1826 (non Daudin, 1803).
Nesaea Risso, 1826 (non Lamarck, 18123).
Donovania Bucquoy, Dautzenberg y Dollfus, 1882 (non Leach, 1814).
Folinaea Monterosato, 1884.
Chauvetiella F. Nordsieck, 1988.
Donovaniella F. Nordsieck, 1988

Chauvetia soni (Bruguière, 1789) (Figs. 2-6, 66, 80-85)

Buccinum 6. Le Soni. Adanson, 1757. *Hist. Nat. Sénégal*, Coquillages, p. 151; pl. 10, G 3, fig. 6. [Localidad tipo: Senegal]
Buccinum soni Bruguière, 1789, ex Adanson. *Encycl. Meth.*, *Vers*, 1, p. 283.
Donovania fasciata Sowerby, 1910. *Proc. Mal. Soc. Lon.*, 9: 65.

Material tipo: No examinado, figurado por FISCHER-PIETTE (1942: lám. VIII, figs. 9-14).

Otro material estudiado: Senegal, Dakar: Madeleines: 12 c, 30 m (MHNS); Ifan Gorée: 3 c (MNHN); Gorée: 6 c, 10 m (MHNS); 2 c, 3 m (MNHN); 6 c (MNHN); 44 c, 5-15 m (MNHN); Gorée, dragado: 5 c, 30 m (MHNS); Thiarouye: 1 c (MNHN); Pecio del "Tacoma": 6 c, 15 m (MHNS); Cap Vert: 3 c (MNHN); 13 c, 20 m (MHNS); sin referencia exacta: 2 c (MHNS); Cap Vert Pecio del "Tacoma": 6 ej, 20 c, 30 m (CJP); La Madeleine: 6 c, 10 m (CJP); Petite Corniche (Cap Vert): 15 c (CJP); Pecio del "Tacoma": 9 ej, 10 m (CJP); Cap Vert: 18 c, 20 m (CJP); Les Blockaus: 10 ej, 13 c (CJP); Cap Vert: 2 ej, 2 c, 1 j, 15 m (CJP); 3 ej, Hotel Oceanium (5D2-15) (6D2-1): 19 ej, 6 m (MHNS); Gorée, costa sur (13D2-8): 5 ej, 8 m (MHNS); 2 c, 5 f, 51 j, en sedimentos entre 20-40 m (MHNS); 1 c (MNHN); Dakar: 21 c (MNHN); 1 c (MNHN, coll. Jouseaume); 10 s, (CPR).

Descripción: Concha (Figs. 2-6, 80, 81) fusiforme poco alargada, sólida, con unas seis vueltas de espira y unas dimensones de hasta 6 mm.

Protoconcha (Figs. 83, 84) con 1,1 vueltas, alcanza una anchura de 570 μm (núcleo: 240 μm, primera media vuelta: 415 μm) y una altura similar. Está ornamentada por cordoncillos (unos veinticinco en el núcleo y una quincena en su parte final) separados por interespacios de anchura similar. En estos interespacios se observan cordoncillos axiales muy irregulares (Fig. 85) lo que confiere a la protoconcha un ligero aspecto reticulado. Los cordones tienen una anchura similar, aunque no son exactamente iguales. Además, la protoconcha presenta, después de la primera media vuelta, una escultura axial formada por una docena de costillitas un poco sigmoideas y levemente opistoclinas. En un principio son equidistantes aunque al final de la misma se van aproximando entre sí. Se considera el punto de la transición con la teleoconcha, cuando estas costillas después de aproximarse se vuelven a distanciar. Un poco antes de ese momento, pueden apreciarse claramente los cordones espirales de la protoconcha y se incian los primeros cordones de la teleoconcha.

Teleoconcha con ornamentación formada por cordones espirales y costillas axiales, de una anchura similar a sus interespacios. En la primera vuelta aparecen dos cordones espirales. Un tercer cordón va apareciendo en la parte más elevada de las vueltas como un reborde inferior a sutura, siendo ya evidente en la tercera vuelta. Este cordón superior es más estrecho que los otros dos y se mantendrán en esta proporción hasta la última vuelta, donde aparece otro más pequeño por encima, siendo por tanto cuatro los que hay por encima de la inserción labial. En la base de la última vuelta, hay de seis a ocho cordones más claramente separados por interespacios, que son de anchura similar en los superiores y más finos y más próximos entre sí los que se encuentran sobre el canal sifonal, donde apenas se distinguen los interespacios. La última vuelta alcanza casi el 60% de la altura total, mientras que la abertura ocupa en torno al 40%. Hay una microescultura espiral solo visible a grandes aumentos.

Abertura (Figs. 66, 82) ovoide, canal sifonal muy corto y ancho. En el interior del labio externo se observan cinco dientecillos, de los cuales el superior es más pronunciado, y el inferior constituye el borde externo del canal sifonal.

El color de la concha es blanco brillante con bandas espirales de color marrón rojizo de distinto grosor que discurren sobre los cordones espirales. Prácticamente todas las conchas estudiadas presentan un patrón típico que consiste en tres bandas coloreadas en la última vuelta por encima de la inserción labial. De éstas, la banda subsutural es más estrecha que las otras dos, que tienen una anchura similar a los cordones. Bajo ellas, a la altura de la inserción labial, se observa otra banda estrecha, que a veces es blanca, y más abajo, tres bandas anchas y otras dos o tres más estrechas.

Animal blanquecino con puntos de color blanco leche.

Distribución: Conocida sólo de Senegal. La cita para Ghana que hace Micali (1999) no está confirmada.

Comentarios: Un ejemplar juvenil de los examinados presentaba cordones rojizos de mayor anchura que la forma típica.

Figuras 2-6. *Chauvetia soni* (Bruguière, 1789), Dakar, 5,8, 5,5, 3,9, 4,3 y 5,0 mm (MHNS). Figuras 7-9. *Chauvetia tenebrosa* spec. nov., Dakar, 4,0, 4,1 y 3,9 mm (MHNS). Figuras 10, 11: *Chauvetia gigantea*, paratipo, Dakar, 8,6 mm (MHNS). Figura 12: *Chauvatia candidissima* (Philippi, 1836). Estrecho de Messina, Italia, 9 mm (CAP). Figuras 13, 14. *Chauvetia affinis* Monterosato, 1889. 13: ejemplar de Dakar, 5,7 mm. 14: ejemplar colectado por Mission Gruvel en Cabo Rojo (MNHN), citado en Dautzenberg (1910), 7,0 mm.

Figures 2-6. Chauvetia soni *(Bruguière, 1789), Dakar, 5.8, 5.5, 3.9, 4.3 and 5.0 mm (MHNS). Figures 7-9.* Chauvetia tenebrosa *spec. nov., Dakar, 4.0, 4.1 and 3.9 mm (MHNS). Figuras 10, 11:* Chauvetia gigantea, *paratype, Dakar, 8.6 mm (MHNS). Figure 12:* Chauvetia candidissima *(Philippi, 1836). Strait of Messina, Italy, 9 mm (CAP). Figures 13, 14.* Chauvetia affinis *Monterosato, 1889. 13: specimen from Dakar, 5.7 mm. 14: specimen collected by Mission Gruvel at Cabo Rojo (MNHN), cited in Dautzenberg (1910), 7.0* mm.

Chauvetia affinis Monterosato, 1889 (Figs. 13, 14, 68, 93-98, 181, 189)

Donovania affinis Monterosato, 1889. *Journ. de Conchyl.*, 37: 20. (Localidad tipo: Casablanca].

Material tipo: Sintipo en la colección Monterosato. No examinado.
Otro material estudiado: Mauritania: Baie de l'Etoile: 6 j, 0-1 m (MHNS); Port Etienne [now Nouhadibou]: 4 c (MNHN). Senegal: Dakar: Sur de Gorée: 2 c, 25 m (MNHN); Este de Gorée: 3 c, 35 m (MNHN); Gorée: 1 c, 5-15 m (MNHN); 7 c, 25 m (MNHN); 1 j (MNHN); entre Gorée y Dakar: 1 c, 4 j (MNHN); Petite Côte: 1 c, 14°39'N 17°20'W (MNHN); Madeleines: 1 c, 1 j, 18 m (MHNS); Grand Thiouriba: 2 j, 30 m (MHNS); Cap Vert: 1 c, 1 j, 33 m (MHNS); 1 ej (6D2-4) (MHNS); 3 ej, (8D3-6) (MHNS); Dakar: 2 ej (10D2) (MHNS); Cap Vert, Pecio del "Tiwa": 4 ej, 35 m (CJP); Sur de M'Bao: 6 c, 30 m (MNHN); Grand Thiouriba: 1 c, 1 j, 40 m (CJP); Pecio del "Tacoma": 1 ej, 15 m (CJP); Sur de Pecio del "Tacoma": 1 c, 25 m (MNHN); Grand Thiouriba: 1 f, 1 j, 40 m (CJP); Cap Vert: 9 c, (MNHN); 2 ej, 0-40 m (CJP); Chartine: 1 ej (CJP); Gouye Teni'Mboth: 7 j, 3 m (CJP); Cape Rouge: 1 c (MNHN); Gouye Teni'Mboth: 4 j, 10 m (CJP); Bahía de Dakar: 2 c, 2 j, sedimentos 20-40 m (MHNS).

Descripción: Concha (Figs. 13, 14, 93) fusiforme, aunque más cilíndrica que otras del género, sólida, con unas seis vueltas de espira, y una máxima dimensión de hasta 6 mm.

Protoconcha (Figs. 95, 96) paucispiral con 0,8 vueltas, una anchura de 430 μm y una altura de 480 μm (núcleo: 270 μm y la primera media vuelta: 425 μm). Su escultura (Fig. 97) está formada, como en otras *Chauvetia*, por cordones espirales planos entre los que se aprecian surcos con incisiones axiales y que, al final, son unos 10 a 12 en número, algo variables, y más anchos que los interespacios. Al final de la protoconcha se aprecian unas cinco costillas axiales.

Teleoconcha con cuatro cordones espirales en la primera vuelta, el inferior más estrecho, y un quinto por arriba que está menos desarrollado y constituye un reborde inferior de la sutura. Un sexto cordón aparece en la penúltima vuelta a partir del cordón superior. La última vuelta representa el 55% de la altura total y, en ella, se aprecian seis cordones por encima de la inserción labial. De ellos los superiores están más juntos y son menos anchos que los restantes. Los interespacios son de una anchura similar a la de los cordones. En la base de la concha hay una decena de cordones que se van aproximando entre sí a medida que se acercan al final del canal sifonal. Las costillas axiales son casi ortoclinas y poco elevadas, y al cruzarse con los cordones espirales se forman tubérculos redondeados muy evidentes (Fig. 98). En la última vuelta hay una veintena de costillas verticales, de anchura similar a los interespacios.

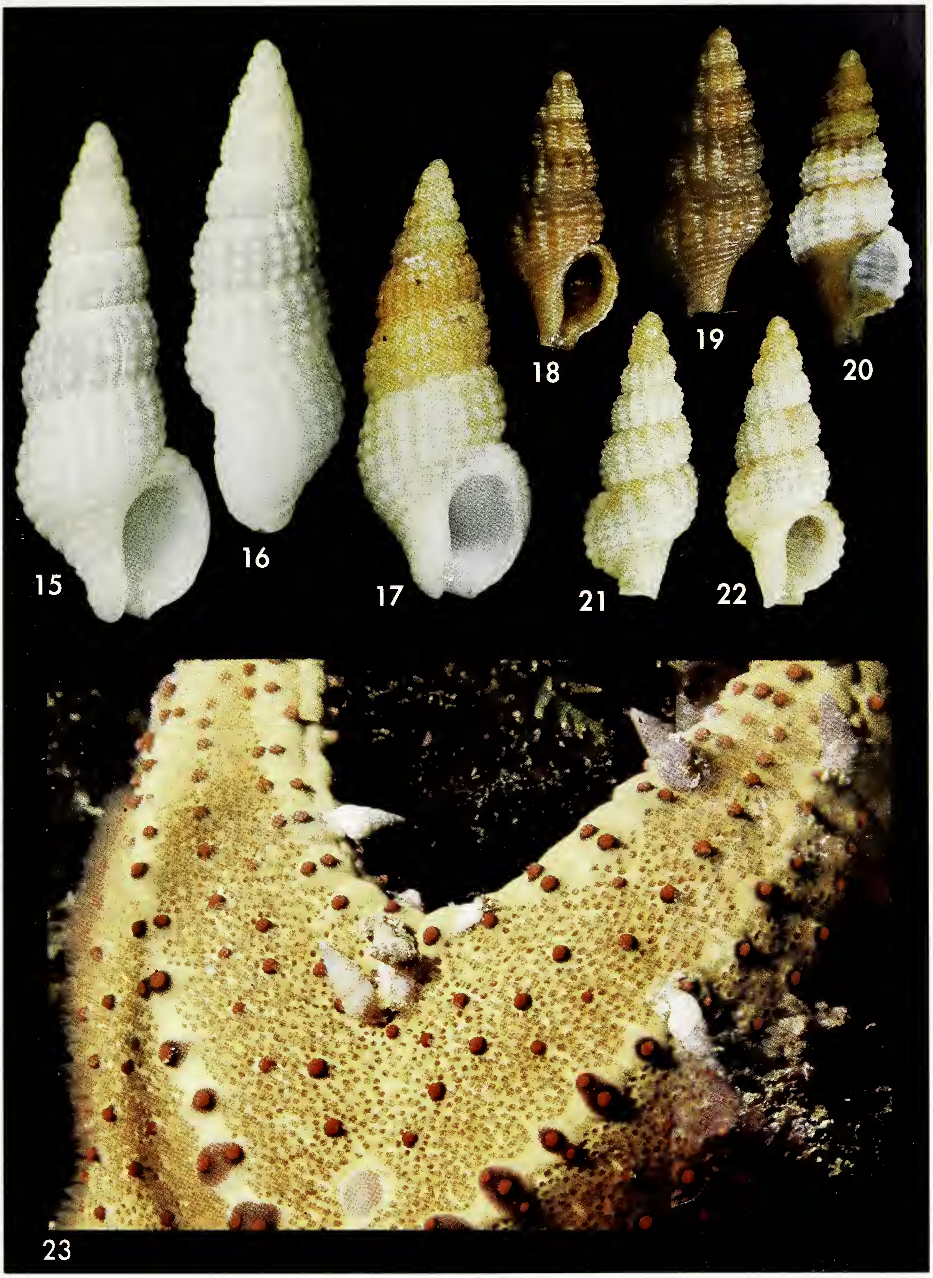
Abertura (Fig. 68, 94) ovoide, representando el 37% de la altura total de la concha. El color de la misma es castaño, igual que la concha, y en ella se observan cinco dientes en el interior del labio externo. El inferior de ellos constituye el inicio del canal sifonal, que es corto y poco aparente.

Coloración de la concha castaño-rojiza. La base es algo más oscura y los tubérculos ligeramente más claros; la protoconcha puede tener un color más claro con una banda oscura en su centro.

Animal blanco crema con aislados puntos blancos. Sifón más intenso de color. Opérculo (Fig. 181) ovoide con el núcleo subterminal. Rádula (Fig. 189) típica, con más de 150 filas de dientes, central rectangular, laterales con tres cúspides, la interna más pequeña.

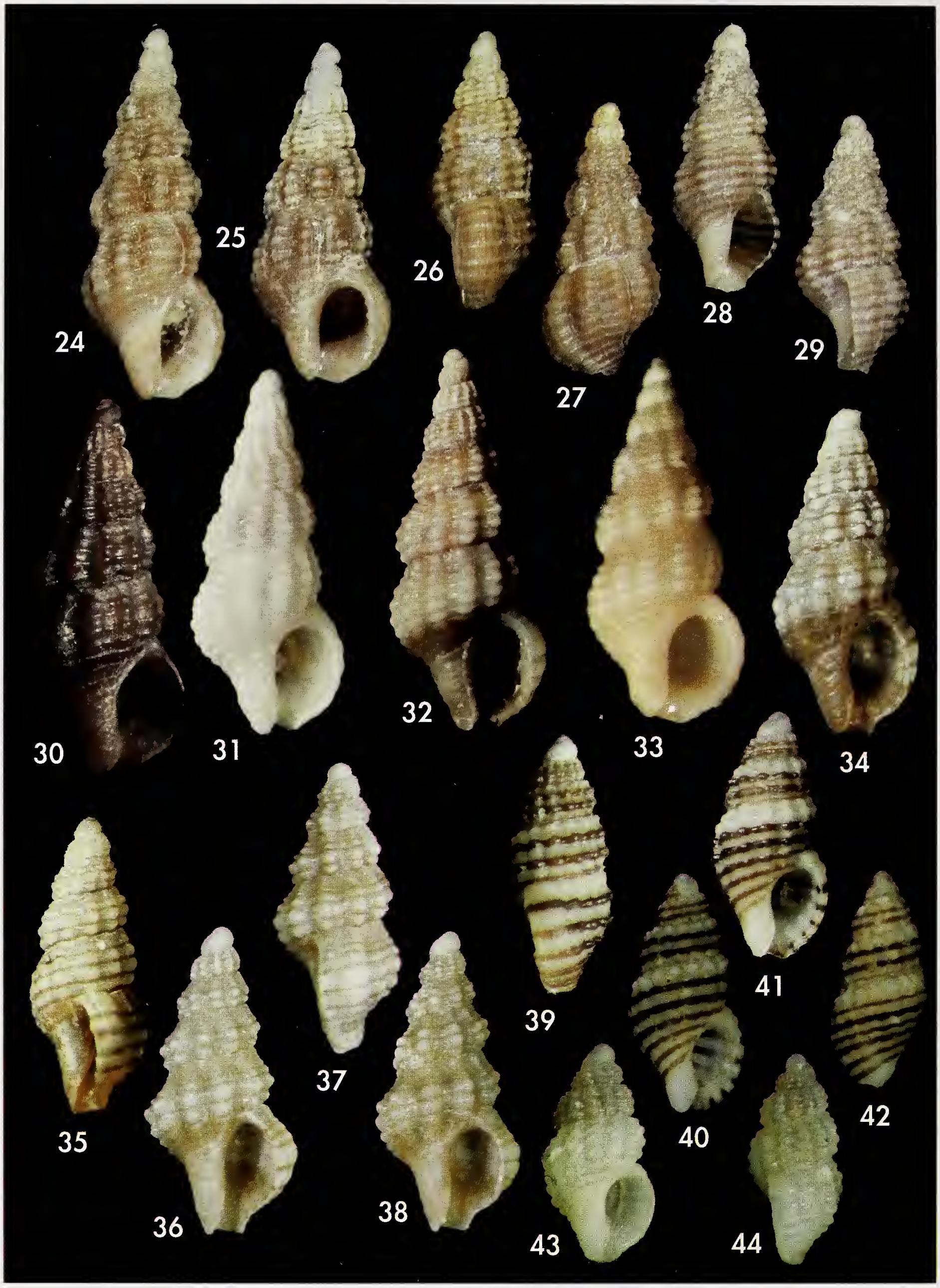
Distribución: Según Monterosato, Casablanca, en Marruecos, y varias localidades del Mediterráneo, como Taormina (Sicilia) y la isla de Pantellaria. Según Dautzenberg (1910) y nuestro material, su área de dispersión se extendería a Mauritania y Senegal, recolectada entre 0 y 40 m.

Comentarios: Monterosato (1889) describe, aunque no ilustra esta especie e indica su parecido con *C. minima* de la que se diferenciaría por su escultura ("como una lima"). Dautzenberg (1910) la cita procedente de dragados frente Bel-Air y al oeste de Cap Rouge y

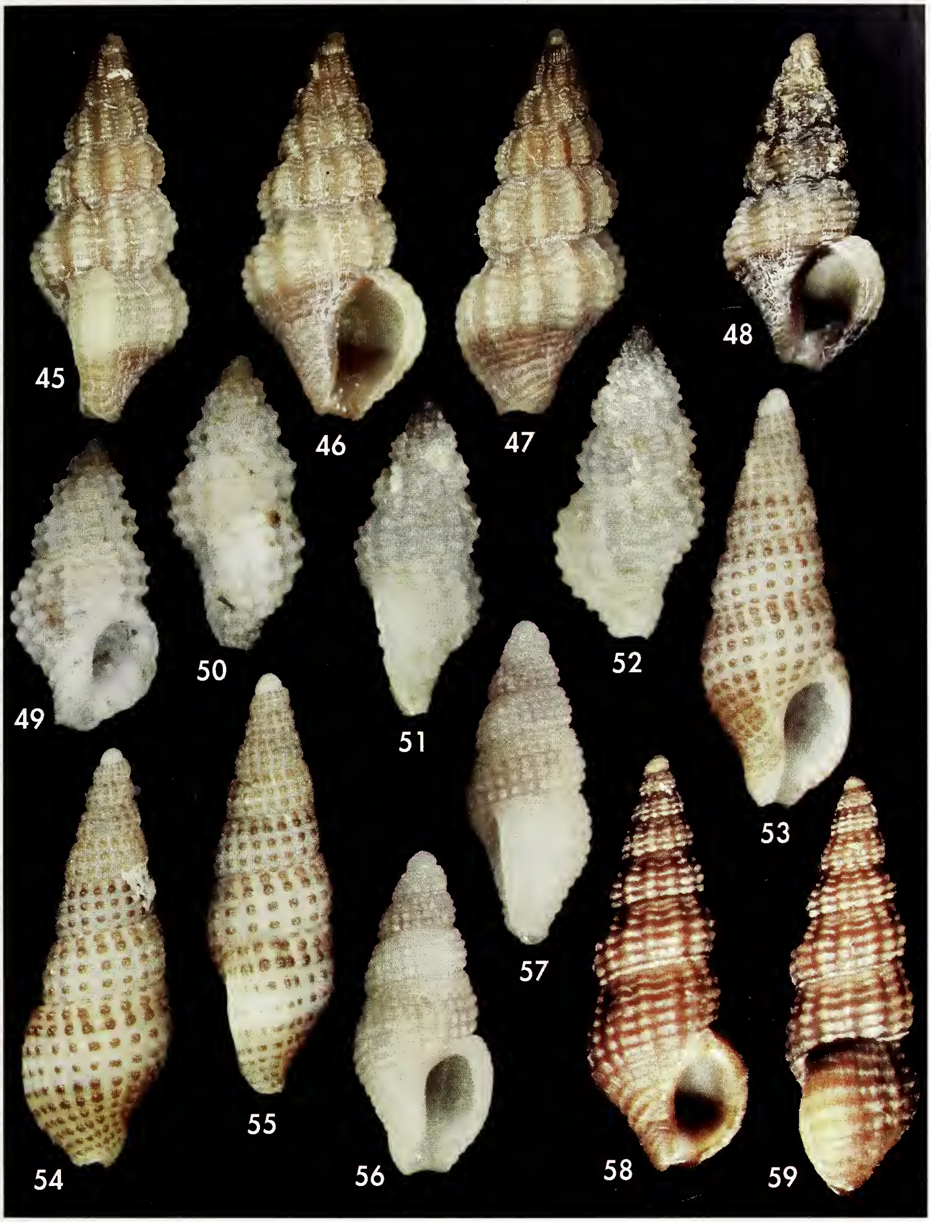


Figuras 15-17. *Chauvetia tenuisculpta* (Dautzenberg, 1891), Dakar, 11,7, 11,7 y 9,8 mm (MHNS). Figuras 18-22. *Chauvetia lamyi* Knudsen, 1956, Dakar, 5,3, 5,3, 5,8, 5,5 y 5,5 mm. Figura 23. Estrella de mar (*Oreaster clavatus* Müller y Troschel, 1842) parasitada por *Chauvetia tenuisculpta*. (fotografía de Patrice Petit De Voize).

Figures 15-17. Chauvetia tenuisculpta *(Dautzenberg, 1891), Dakar, 11.7, 11.7 and 9.8 mm (MHNS). Figures 18-22.* Chauvetia lamyi *Knudsen, 1956, Dakar, 5.3, 5.3, 5.8, 5.5 and 5.5 mm. Figure 23. Sea star (*Oreaster clavatus *Müller and Troschel, 1842) parasitized by* Chauvetia tenuisculpta. *(photograph by Patrice Petit De Voize).*



Figuras 24-33. *Chauvetia joani* spec. nov., Dakar, paratipos, 6,9, 6,4, 5,3, 5,0, 4,9, 4,8, 6,1, 6,3, 6,7 y 6,3 mm (MHNS). Figuras 34-38. *Chauvetia pelorcei* spec. nov., Dakar, paratipos, 4,2, 4,3, 4,2, 4,6 y 4,3 mm (MHNS). Figuras 39-44. *Chauvetia pardofasciata* spec. nov., Dakar, forma típica: 3,9, 3,7, 3,4 y 3,1 mm (MHNS); forma blanca: 3,3 y 3,0 mm (MHNS).
Figuras 24-33. Chauvetia joani *spec. nov., Dakar, paratypes, 6.9, 6.4, 5.3, 5.0, 4.9, 4.8, 6.1, 6.3, 6.7 and 6.3 mm (MHNS). Figures 34-38.* Chauvetia pelorcei *spec. nov., Dakar, paratypes, 4.2, 4.3, 4.2, 4.6 and 4.3 mm (MHNS). Figures 39-44.* Chauvetia pardofasciata *spec. nov., Dakar, typical morph: 3.9, 3.7, 3.4 and 3.1 mm (MHNS); white morph: 3.3 and 3.0 mm (MHNS).*



Figuras 45-48. *Chauvetia javieri* spec. nov. Dakar; 45-47: paratipo, 7,6 mm (MNHN); 48: paratipo, 7,2 mm (MHNS). Figuras 49-52. *Chauvetia robustalba* spec. nov., Dakar, 5,4, 5,4, 5,5 y 5,6 mm (MHNS). Figuras 53-55. *Chauvetia luciacuestae* spec. nov., Dakar, 8.8 mm. Figuras 56, 57. *Chauvetia multilirata* spec. nov. 5,8 mm, holotipo (MNCN). Figuras 58, 59. *Chauvetia pardacuta* spec. nov. Dakar, 6,2 mm.

Figures 45-48. Chauvetia javieri *spec. nov. Dakar; 45-47: paratype, 7.6 mm (MNHN); 48: paratype, 7.2 mm (MHNS). Figuras 49-52.* Chauvetia robustalba *spec. nov., Dakar, 5.4, 5.4, 5.5 y 5.6 mm (MHNS). Figures 53-55.* Chauvetia luciacuestae *spec. nov., Dakar, 8.8 mm. Figures 56, 57.* Chauvetia multilirata *spec. nov. 5.8 mm, holotype (MNCN). Figures 58, 59.* Chauvetia pardacuta *spec. nov. Dakar, 6.2 mm.*

muestra un dibujo de la concha aunque no aporta detalles descriptivos. NORDSIECK (1976) describe también la especie y la ilustra a partir de una concha procedente de Rhodas. MICALI (1999) tras examinar los ejemplares etiquetados como *Donovania affinis* de la colección de Monterosato procedentes de Casablanca y de localidades mediterráneas concluye que el taxon *Donovania affinis* Monterosato, 1889 es una sinonimia de *Chauvetia turritellata* (Deshayes, 1835). Para probarlo aporta una fotografía de una concha procedente de Scilla. Comenta que el ejemplar dibujado por Dautzenberg es similar a ejemplares de *Chauvetia brunnea* procedentes de Tipaza (Argelia).

En nuestra opinión la especie descrita aquí y presente en Dakar, se corresponde con la identificada como *C. affinis* (Fig. 14) por DAUTZENBERG (1910). Por lo que respecta a las citas mediterráneas de *C. affinis* coincidimos con Micali en considerarlas variedades de otras *Chauvetia* mediterráneas como *C. brunnea* o *C. turritellata*.

Chauvetia tenuisculpta (Dautzenberg, 1891) (Figs. 15-17, 69, 99-104, 184, 185)

Donovania candidissima var. *tenuisculpta* Dautzenberg, 1891. *Mém. Soc. Zool. France*, 4: 41, pl. 3 fig. 3a-c.

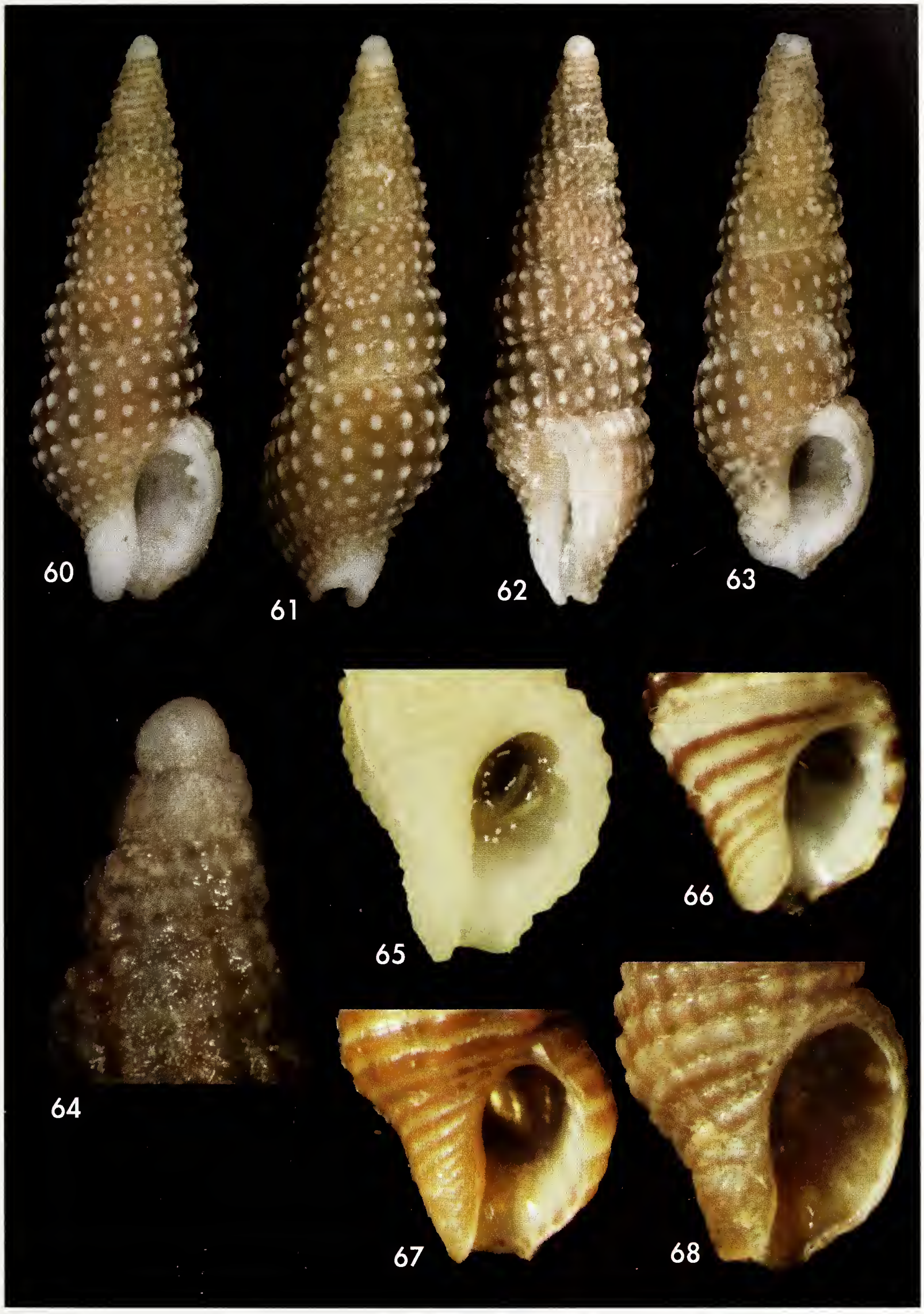
Material tipo: No examinado.

Material estudiado: España: Cádiz: 2 ej (MNCN). Italia: 2 ej (CAP). Senegal: Dakar: 6 s (CPR); Gorée: 115 c, en la playa (MNHN); 3 c, 10 m (MHNS); 8 c (MNHN); Puerto de Gorée: 7 c, 4-5 m (MNHN); al este del Castillo de Gorée: 5 c, sobre estrellas (MNHN); Grand Thiouribe: 1 c (MHNS); Cap Vert: 66 c (MNHN); 3 c, 30 m (MHNS); Bahía de Dakar, dragado: 3 ej, 16 c, 3 j, 20-40 m (MHNS); Gouye Teni M'Both: 7 ej, 1 c, 20 m (CJP); Cap Vert: 20 ej, 30 c, 20 j, 15-30 m (CJP); Hotel Oceanium (6D2-7): 1 ej, 6 m (MHNS); Charbonier, 3 ej (CJP); Gorée, costa sur (13D2-9): 3 ej, 2 c (MHNS); sedimentos Bahía de Dakar, 30 j, 20-40 m (MHNS); 79 c, 2 j (MNHN); 4 c (MNHN, coll. Staadt); 2 c, 10° 19' N, 16° 34' W, 60 m (MNHN).

Descripción: Concha (Figs. 15-17, 99) oblongo fusiforme, sólida, con unas ocho vueltas y una dimensión máxima de hasta 11,1 mm.

Protoconcha (Figs. 101, 102) con 0,9 vueltas y una anchura en torno a 850 μm (núcleo: 430 μm; primera media vuelta: 730 μm) y una altura de 670 μm. Está ornamentada por fuertes costillas (alrededor de una quincena) que ya se inician en el mismo núcleo. La transición con la teleoconcha no es tan clara como en otras especies. Se ha considerado el final de la protoconcha el punto en el que las costillas se vuelven a distanciar tras la aproximación que habían tenido al final de la protoconcha. Con gran aumento (Fig. 103) se aprecia que entre las costillas existe una microescultura de líneas espirales algo irregulares.

Teleoconcha con un perfil de las vueltas ligeramente convexo. Sutura levemente ondulada. En la primera vuelta hay tres cordones espirales, el cuarto está presente ya en la tercera y el quinto aparece en la sexta vuelta, por debajo de la sutura y es menos ancho que los cuatro restantes. Estos cordones espirales son un poco más anchos que los interespacios. En la última vuelta hay cinco cordones por encima de la inserción labial y, por debajo, hay cinco cordones más, claramente separados por interespacios y unos siete cordoncillos más, muy juntos en el canal sifonal. En la última vuelta se observan una veintena de costillas, que son similares a sus interespacios. Abertura (Fig. 69, 100) ligeramente ovoide, canal sifonal corto y ancho. En el interior del labio interno pueden verse seis dientecillos, de los cuales el superior es más pronunciado y el inferior constituye el borde externo del canal sifonal. La última espira ocupa aproximadamente el 50% de la altura total y la boca un 35 % de la altura (las medidas coinciden en lo esencial con MICALI, 1999).



Figuras 60-64. *Chauvetia gigantea* spec. nov., Dakar. 60-62: holotipo, 13,9 mm (MNHN); 63: paratipo: 13,5 mm (CJP); 64: ápice, holotipo. Figuras 65-68. Detalle de la abertura. 65: *C. gigantea*; 66: *C. soni*; 67: *C. tenebrosa*; 68: *C. affinis.*

Figures 60-64. Chauvetia gigantea *spec. nov., Dakar. 60-62: holotype, 13.9 mm (MNHN); 63: paratype: 13.5 mm (CJP); 64: apex of the holotype. Figures 65-68. Detail of the aperture. 65:* C. gigantea*; 66:* C. soni*; 67:* C. tenebrosa*; 68:* C. affinis.

Color de la concha blanco leche. A veces se aprecian zonas del periostraco con una tinción marrón rojiza (Fig. 17), con aspecto ferruginoso.

Animal blanquecino con puntos muy pequeños de color blanco-leche. Opérculo (Figs. 104, 184) ovoide con el núcleo subterminal.

Rádula (Fig. 185) típica del género con diente central rectangular y laterales alargados con tres cúspides curvas y afiladas.

Distribución: Se ha citado desde las costas italianas y de Argelia y hemos visto material de estas localidades. Sin embargo estas citas, muy aisladas, podrían ser ejemplares transportados por pescadores por lo que, de momento, la consideramos una especie oeste africana del área de Dakar. En la página de CLEMAM (http://www.somali.asso.fr/clemam/index.clemam.html), *Ch. tenuisculpta* no aparece como una especie con entrada propia debido a que se encuentra fuera del área de estudio.

Comentarios: Micali (1999) comenta algunas diferencias en la protoconcha y en la aparición del quinto cordón espiral entre las conchas mediterráneas (de Orán) y las de Senegal. En nuestro material no se han visto diferencias significativas.

Una observación recientemente realizada por el malacólogo Jacques Pelorce (com. pers.) sobre esta especie es que ha sido encontrada parasitando a una estrella de mar (*Oreaster clavatus* Müller y Troschel, 1842) (Fig. 23), habiendose visto numerosas estrellas con estos parásitos y más de 10 ejemplares, tanto jóvenes como adultos, fuertemente pegados sobre una sola estrella.

La especie más parecida es *C. candidissima*, pero se diferencia por la más escasa presencia de costillas axiales en la protoconcha y por su escultura de cordones y costillas más separadas.

Dadas las diferencias de la protoconcha, nuestra opinión es la misma que la de Micali (2005), es decir, que son dos especies diferentes y fácilmente diferenciables por su protoconcha: *C. candidissima* en el Mediterráneo y *C. tenuisculpta* en el área de Dakar.

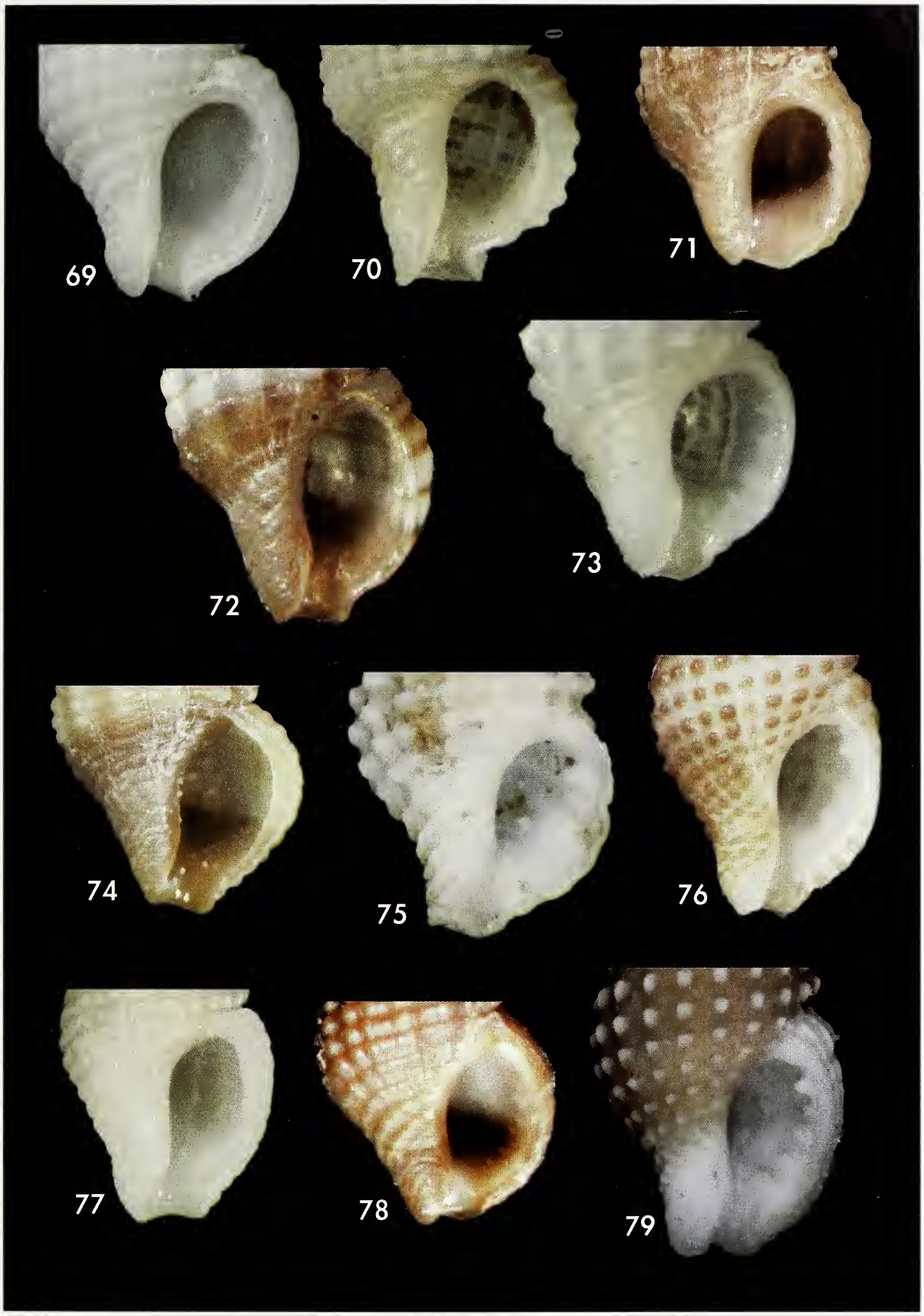
Chauvetia lamyi Knudsen, 1956 (Figs. 18-22, 70, 105-113, 186)

Chauvetia lamyi Knudsen, 1956. *Atlantide Report*, 4: 43, lám. 3, figs. 17, 18. [Localidad tipo: St. 56]

Material tipo: No examinado. Supuestamente en ZMUC.
Otro material estudiado: Mauritania: Bahía de l'Etoile: 1 c, intermareal (MHNS); Port Etienne [now Nouhadibou]: 1 j (MNHN). Senegal: Dakar: 8 c (CPR); 2 c, 13° 57′ N, 17° 15′ W, 50 m (MNHN); Gorée: 14 ej, 20-40 m (MHNS); sur de Gorée: 4 c, 32-34 m (MNHN); 1 c, 42 m (MNHN); 2 c, 38-42 m (MNHN); 3 c (MNHN); 7 c, 95 m (MNHN); 2 ej, 4 c, 6 m (MHNS); 1 c, 14° 32 ′N, 17° 25′ 30″ W, 50 m (MNHN); entre Gorée y Dakar: 2 c (MNHN); Cap Vert, Tacoma: 5 ej, 10-15 m (CJP); Cap Vert: 2 ej, 0-40 m (CJP); Petite Côte: 4 c, 14° 36′ N, 17° 19′ W, 32 m (MNHN); Joal: 2 c, 55 m (MNHN); SW Madeleine: 3 c, 47 m (MNHN); SW Cap Manuel: 1 c, 32 m (MNHN); 1 c, 250 m (MNHN); Charbonier: 5 j, 34 m (CJP); Delta del Saloum: 54 c, 13° 47′ N, 17° 15′ W, 50 m (MNHN); 18 c, 50 m (MNHN). Ghana: Miamia: 3 s, 10-15 m (CPR).

Descripción: Concha (Figs. 18-22, 105, 106) fusiforme, sólida, con unas seis vueltas de espira y una dimensión máxima de hasta 6 mm.

Protoconcha (Figs. 108-111) con 0,9 vueltas de espira, una anchura de unas 540 μm y una altura similar. Su núcleo es proporcionalmente ancho (núcleo 290 μm; primera media vuelta: 500 μm). La escultura de la protoconcha está formada por unos 18 a 20 cordones desiguales, claramente más anchos que los interespacios (la mayoría de los cordones son entre dos y tres veces más anchos). Los interespacios, como en la mayoría de las especies de *Chauvetia* presentan incisiones axiales (Figs. 112, 113). En el final de la protoconcha se aprecian 6 a 9 cordones axiales que discurren sobre las costillitas finales de la protoconcha.



Figuras 69-79. Detalle de la abertura: 69: *C. tenuisculpta*; 70: *C. lamyi*; 71: *C. joani*; 72: *C. pelorcei*; 73: *C. pardofasciata*; 74: C. *javieri*; 75: C. *robustalba*; 76: *C. luciacuestae*; 77: C. *multilirata*; 78: C. *pardacuta*; 79: *C. gigantea*.
Figures 69-79. Detail of the aperture: 69: C. tenuisculpta*; 70:* C. lamyi*; 71:* C. joani*; 72:* C. pelorcei*; 73:* C. pardofasciata*; 74:* C. javieri*; 75:* C. robustalba*; 76:* C. luciacuestae*; 77:* C. multilirata*; 78:* C. pardacuta*; 79:* C. gigantea.

Teleoconcha con vueltas de perfil convexo y la sutura profunda y algo ondulada. Se considera iniciada cuando comienzan a distanciarse las costillas axiales y desaparece la escultura espiral de la protoconcha. En la primera espira hay cuatro cordones espirales evidentes y un quinto superior poco definido y con aspecto de reborde subsutural. Los cordones son de anchura similar a los interespacios. Las costillas son ortoclinas con una leve inclinación prosoclina en las espiras superiores. Estas costillas pueden estar algo curvadas y son algo más estrechas que los interespacios. En la última espira hay cinco cordones por encima de la inserción labial claramente separados por interespacios de igual tamaño. Ocasionalmente puede aparecer un sexto cordón subsutural como reborde. Por debajo de la inserción labial hay de diez a doce cordones separados por interespacios claramente más estrechos. Sobre el canal sifonal están los cordones juntos siendo ésta una característica de la especie. En la última espira hay de doce a quince costillas más estrechas que los interspacios que no sobrepasan la inserción labial quedando el canal sifonal libre de ellas. Entre las costillas se pueden observar numerosas líneas de crecimiento claras. La última vuelta ocupa un 57 % de la altura total.

Abertura (Figs. 70, 107) ovoide con seis dientes en el interior del labio externo. Canal sifonal claro, más evidente y más cerrado que en otras especies, estando algo inclinado hacia la izquierda.

El color de la mayor parte de las conchas es castaño rojizo con la base algo más oscura. Una concha presentaba una amplia franja blanca en las dos últimas vueltas. Otra concha, más clara de color amarillento, se comentará más abajo.

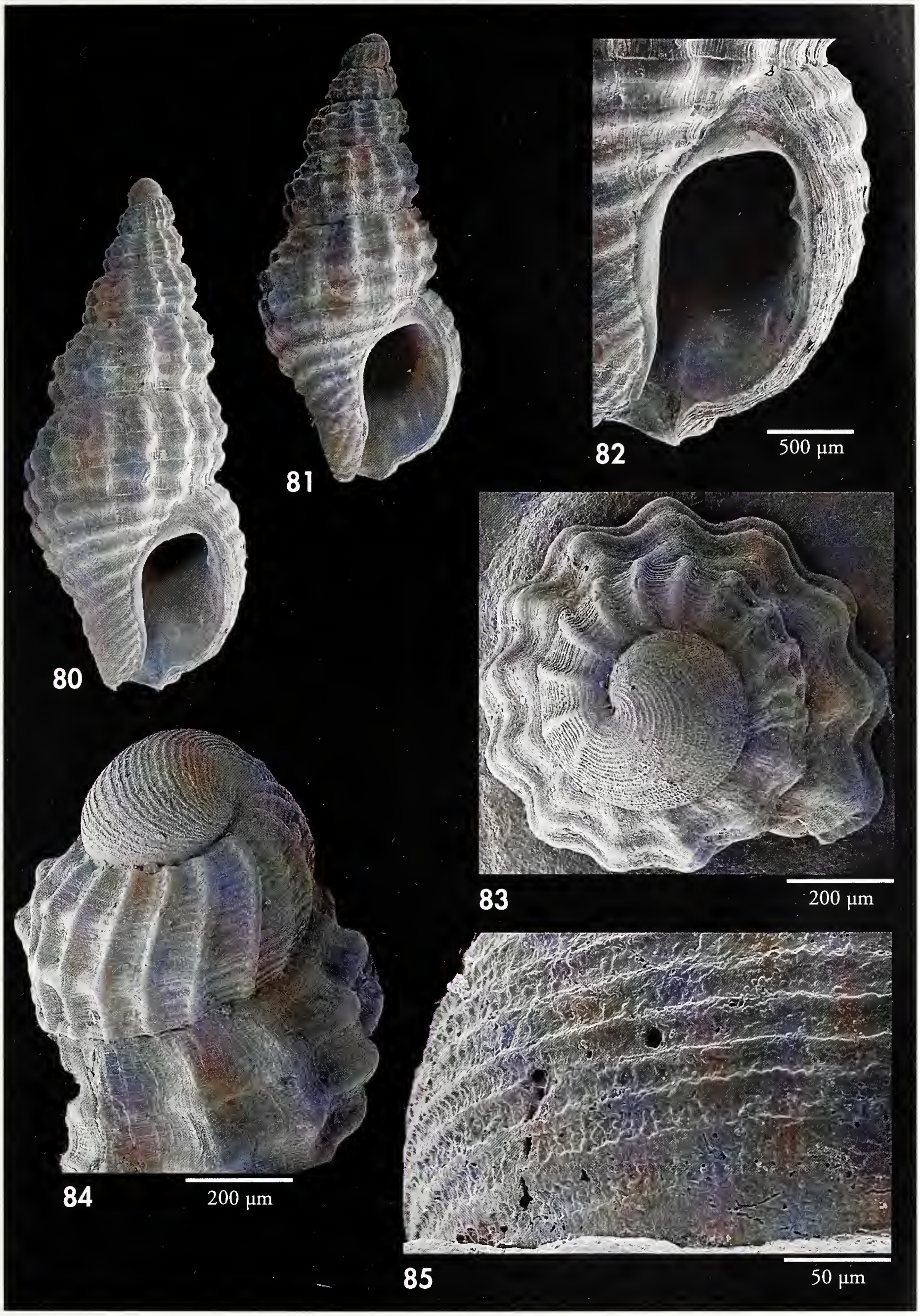
Animal de color crema con multitud de puntos blanco-leche. Opérculo ovoide con núcleo subterminal. Rádula (Fig. 186) con diente central rectangular con una única cúspide y laterales con tres.

Distribución: Según el trabajo de descripción original, entre Senegal y Costa de Marfil. En nuestro material es conocida del área de Dakar, entre 0 y 40 m, y también de Mauritania.

Comentarios: Una concha muy clara de color (Figs. 21, 22), es también fusiforme pero algo más cilíndrica que la forma normal, y con seis vueltas de espira alcanza 5,5 mm de altura y 2,1 mm de anchura. La protoconcha (Figs. 108, 110) de esta supuesta variedad clara es similar en su tamaño y anchura (555 μm), pero su núcleo es más pequeño (255 μm) (primera media vuelta: 435 μm). La escultura del único ejemplar está algo desgastado pero los cordones que se aprecian parecen ser menos anchos y el número de costillas axiales es algo menor. La última vuelta ocupa el 54 % de la altura y la abertura el 37%. La teleoconcha está ornamentada con cordones espirales relevantes de anchura similar a los interespacios y con costillas menos relevantes con anchura algo menor que los interespacios con una inclinación algo prosoclina. Hay unos cuatro cordones en la primera vuelta, en la tercera son ya cinco que se mantienen por encima de la inserción bucal en la última vuelta. Un sexto cordón subsutural se insinúa como un reborde. Los dos cordones superiores son algo más estrechos que los inferiores. En la base de la concha hay unos nueve cordones espirales más separados por claros interespacios. En la última vuelta presenta una veintena de costillas, de anchura similar a los interespacios, ortoclinas o ligeramente prosoclinas. Abertura bucal oval con un canal sifonal claro más corto que en la variedad oscura y menos inclinado. Siete dientes en la cara interna del labio externo siendo el inferior el límite externo del canal sifonal. Si esta forma es algo taxonómicamente diferente, sólo podrá deducirse en el futuro del estudio de más material.

Chauvetia gigantea spec. nov. Oliver, Rolán y Pelorce (Figs. 10, 11, 60-65, 79, 86-88)

Chauvetia candidissima: Micali, 1999. *Boll. Malac.*, 34: fig. 2.



Figuras 80-85. *Chauvetia soni* (Bruguière, 1789), Dakar. 80: concha con el patrón habitual de color, 5,8 mm (MHNS); 81: concha con patrón poco habitual, misma que en fig. 6, 5,0 mm (MHNS); 82: detalle de la abertura; 83, 84: protoconcha; 85: detalle de la microescultura.

Figures 80-85. Chauvetia soni *(Bruguière, 1789), Dakar. 80: shell with the usual colour pattern, 5.8 mm (MHNS); 81: shell with unusual pattern, same as in fig. 6, 5.0 mm (MHNS); 82: detail of the aperture; 83, 84: protoconch; 85: detail of the microsculpture.*

Material tipo: Holotipo (Figs. 60-62) en MNHN; un paratipo (Fig. 63) en CJP; otro (Figs. 10, 11) en MHNS. Otro paratipo (representado en MICALI, 1999, fig. 2) en la colección de Giunchi-Tisselli (San Zaccaria).
Localidad tipo: Epopal, Dakar, 14º 36′ 270″ N, 17º 25′ 629″ W, 32 m (Septiembre/2007).
Etimología: El nombre específico alude a su tamaño, que es el mayor de las especies conocidas en este género.

Descripción: Concha (Figs. 60-63) fusiforme-alargada, sólida, con unas siete vueltas de espira y una altura máxima supuesta de más de 14 mm.

Protoconcha (Figs. 64, 87) con 0,6 vueltas, y con una anchura de unos 800 μm (núcleo: 550 μm, primera media vuelta: 800 μm) y unas 700 μm de altura; está un poco erosionada, pero se aprecia escultura espiral marcada.

Teleoconcha con una escultura de cordones espirales algo más estrechos que sus interespacios y costillas bastante más estrechas que sus interespacios. En el inicio de la teleoconcha aparecen tres cordones espirales. En la cuarta vuelta aparece por encima de la sutura un cuarto cordón. En la última vuelta hay cuatro cordones por encima de la inserción labial y, hacia la base, aparecen de diez u once cordoncillos más. Los superiores están claramente separados por interespacios claros y a medida que se acercan al canal sifonal se van aproximando entre ellos, quedando los más inferiores prácticamente juntos. La escultura axial es similar en grosor y está formada por costillas ortoclinas o muy poco prosoclinas, que son unas dieciocho en la última vuelta. Se prolongan por debajo de la inserción labial acabando cerca del inicio del canal sifonal. Al cruzarse cordones y costillas se forman nódulos ovoides o rectangulares. La ultima vuelta ocupa el 46 % de la altura total de la concha. Microescultura muy fina (Fig. 88).

Abertura (Figs. 79) oval que alcanza el 26% de la altura de la concha. En el interior del labio externo se aprecian cinco dientes de los que el superior es más pronunciado y el inferior constituye el borde externo del canal sifonal, que es corto y está algo girado hacia la izquierda.

Color de la concha castaño claro o blanquecino, con la protoconcha, la base y la abertura blancas. Los nódulos son todos perfectamente blancos distinguiendose sobre el fondo castaño. Periostraco castaño.

Dimensiones: Holotipo 13,9 x 4,7 mm; paratipos de unas dimensiones similares.

Animal desconocido.

Distribución: Sólo conocida de la Bahía de Dakar, viviendo en fondos rocosos basálticos, a una profundidad de alrededor de 32 m.

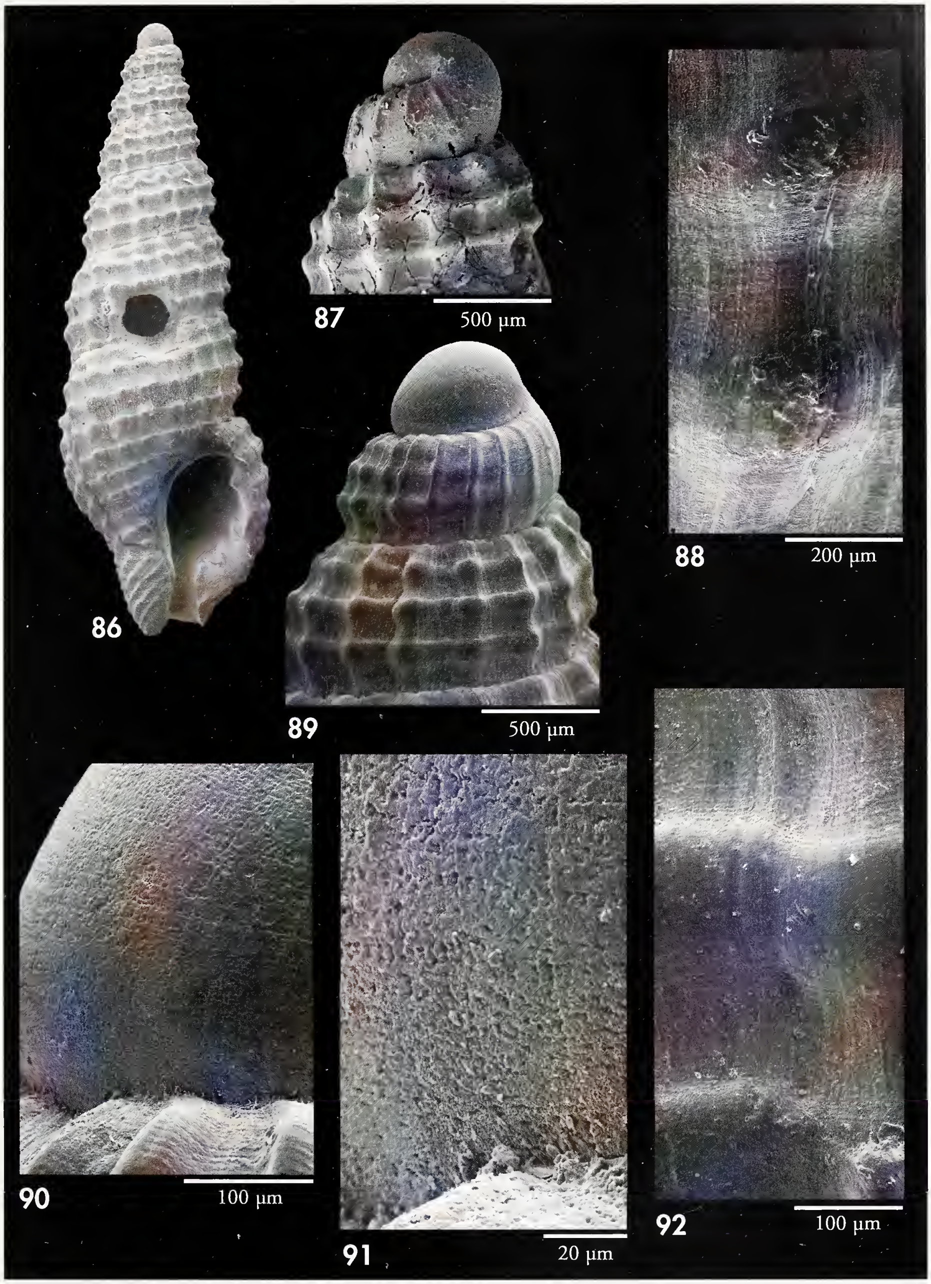
Comentarios: Esta especie por su tamaño (casi el doble de la mayoría de las especies del género) se diferencia de todas las conocidas tanto del Mediterráneo como de Senegal. Por otra parte, el patrón de color es totalmente diferente de todas ellas, apareciendo como un negativo de otras especies, que tienen un patrón de color de nódulos castaños sobre un fondo más claro, como *C. luciacuestae* spec. nov., de Senegal, y del Mediterráneo, *C. lefebvrei* (Maravigna, 1840), y algunas formas de otras especies.

Cuando carece de periostraco, por su tamaño grande, podría confundirse con *C. tenuisculpta*, pero en esta son diferentes la coloración de la concha y la fuerte escultura axial de la protoconcha.

Chauvetia candidissima (Philippi, 1836) del Mediterráneo (Fig. 12) es más blanca, más ancha y más sólida y tiene 4 cordones espirales por vuelta. La protoconcha (Fig. 90) tiene un mayor número de cordones en la zona de transición a la teleoconcha y una microescultura muy fina (Fig. 91).

Chauvetia tenebrosa spec. nov. (Figs. 7-9, 67, 114-120)

Material tipo: Holotipo (Fig. 115) en el MNCN (15.05/47536). Paratipos en las siguientes colecciones: AMNH (1), BMNH 20080487 (1), MNHN (1, Fig. 114), MNHN (20 c, 12 m), MNHN (9 c), MHNS



Figuras 86-88. *Chauvetia gigantea* spec. nov. 86: paratipo, Dakar, 8,6 mm (MHNS); 87: protoconcha, Dakar; 88; detalle de la microescultura, Dakar. Figuras 89-92: *Chauvetia candidissima* (Philippi, 1836); 89: protoconcha, de un juvenil de Malta; 90, 91: detalle de la microescultura de la protoconcha; 92: detalle de la microescultura de la teleoconcha.

Figures 86-88. Chauvetia gigantea *spec. nov. 86: paratype, Dakar, 8.6 mm (MHNS); 87: protoconch, Dakar; 88; detail of the microsculpture, Dakar. Figures 89-92:* Chauvetia candidissima *(Philippi, 1836); 89: protoconch of a juvenile from Malta; 90, 91: detail of the microsculpture of the protoconch; 92: detail of the microsculpture of the teleoconch.*

(20 c, 13 j), USNM (1), CJH (1), CPR (1), CDO (5), CJP (5 ej, 9 c). Todos ellos de la localidad tipo. Otros paratipos de Dakar, Senegal: Les Madeleines, 3 c, 1 j, 18 m (MHNS); Gorée: 3 c, 3 j, 6 m (MHNS); Cap Vert: 12 c, 13 m (MHNS); Cap Vert: 2 c, 30 m (CJP); Dakar: 2 ej, (8D3-7) (MHNS); 1 ej, Bahía de Gorée (CJP); 35 c, Bahía de Gorée, 5-15 m (MNHN); Cap Vert, Pecio del "Tacoma": 2 c, 13 m (MHNS); Dakar (sin localidad): 6 c (CJP); Bahía de Dakar, 1 ej, (13D2-8), 5 c, 60 j, 20-40 m (MHNS); Gorée: 2 ej, 18 m (13D2-6) (MHNS).
Localidad tipo: Pecio del "Tacoma", Dakar, Senegal, entre 20 y 30 m.
Etimología: El nombre específico alude al oscuro color de la concha.

Descripción: Concha (Figs. 7-9, 114, 115) fusiforme alargada, con unas 4-5 vueltas y unas dimensiones máximas de hasta 4.0 mm.

Protoconcha (Figs. 117, 118) con una vuelta de espira, y unas dimensiones de 472 μm de diámetro (el núcleo, 212 μm, la primera media vuelta 340 μm, y una altura de 327 μm. Está ornamentada con unos 13 ó 14 cordoncillos irregurales, con los espacios intermedios en los que aparece una microescultura (Fig. 119) muy irregular, en la que las costillitas axiales se distinguen con dificultad. Hacia el final de la protoconcha, hay unas 3-4 costillas axiales antes de iniciarse la escultura típica de la teleoconcha.

Teleoconcha con unas cuatro vueltas algo convexas y que presentan 4 cordones en las primeras vueltas y, por encima de la inserción labial, 5 ó 6 en la última, los dos superiores muy pequeños; además, por debajo, hay unos 10 cordones más que se van juntando hacia la base. Abertura (Figs. 67, 116) algo ovoide, con cinco dientes en el interior del labio externo y un canal sifonal abierto y corto.

Coloración de la concha castaña oscura, pero los interespacios entre los cordones espirales son algo más claros, por lo que estos destacan sobre el fondo.

Dimensiones: el holotipo tiene unas dimensiones de 3,6 x 1,5 mm; los ejemplares mayores llegan habitualmente hasta 4.0 mm, aunque algún ejemplar enorme alcanzó los 4,8 mm.

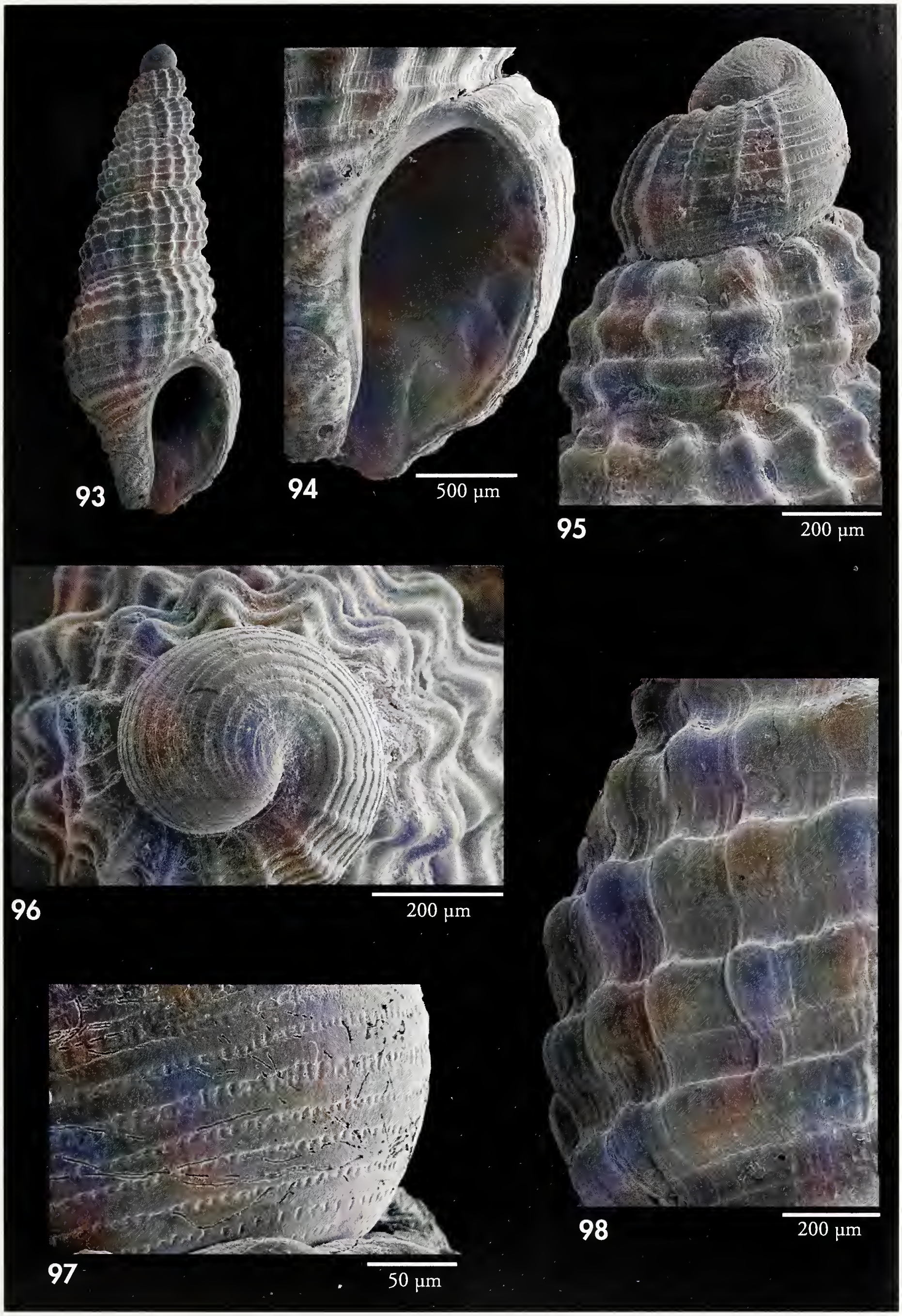
Animal: se hicieron observaciones sobre unos pocos ejemplares que fueron recolectados vivos. El animal tiene un color de fondo blanquecino, o ligeramente crema con puntos blancos, que se observan en el extremo del sifón y en la base, mientras que todo el dorso es de color negro intenso.

Distibución: Conocida del área de Dakar, Senegal.

Discusión: *C. tenebrosa* tiene un aspecto general que recuerda el de la concha de *C. brunnea* (Donovan, 1804). La descripción de esta última especie puede verse en FRETTER Y GRAHAM (1984), MIFSUD (1994), MICALI (1999), aunque hay una clara dificultad para determinar con precisión las diferencias del taxón *C. brunnea* con las especies más próximas, *C. mamillata* Riso, 1826, y *C. turritellata* Deshayes, 1835. Este problema se afrontará en una revisión, actualmente en curso, sobre las especies del Mediterráneo y su comparación con las del Atlántico y norteafricanas.

Las diferencias de *Chauvetia tenebrosa* spec. nov. con *C. brunnea* (de las costas de Galicia y de la Bretaña francesa) son las siguientes: *C. brunnea* tiene un mayor tamaño, con un color castaño uniforme, los cordones espirales más aplanados, más del doble de anchos que sus interespacios, y la protoconcha es más ancha. El diámetro de la protoconcha de *C. brunnea* es referido por FRETTER Y GRAHAM (1984) como teniendo entre 650 y 1000 μm. THIRIOT-QUIÉVREUX Y RODRÍGUEZ BABIO (1975, lám. 6B) muestran una fotografía en la que este diámetro es de unos 450 μm, pero en el material de la Bretaña francesa examinado por nosotros, el diámetro está entre 500 y 750 μm; en todos los casos examinados, mayor que el de *C. tenebrosa*. Otra diferencia es la escultura de los interespacios entre los cordoncillos de la protoconcha que, en *C. brunnea*, tienen una escultura de muescas axiales bien definida (THIRIOT-QUIÉVREUX Y RODRÍGUEZ BABIO, 1975), mientras que, en *C. tenebrosa* (Fig. 119) la escultura es muy tenue y mal definida.

Las diferencias con *Chauvetia joani* spec. nov. pueden verse en el apartado de comentarios de esta especie.



Figuras 93-98. *Chauvetia affinis*. 93: concha, 5,7 mm; 94: detalle de la abertura; 95, 96: protoconcha; 97: detalle de la microescultura de la protoconcha; 98: detalle de la microescultura de la teleoconcha.

Figures 93-98. Chauvetia affinis. *93: shell, 5.7 mm; 94: detail of the aperture; 95, 96: protoconch; 97: detail of the microsculpture of the protoconch; 98: detail of the microsculpture of the teleoconch.*

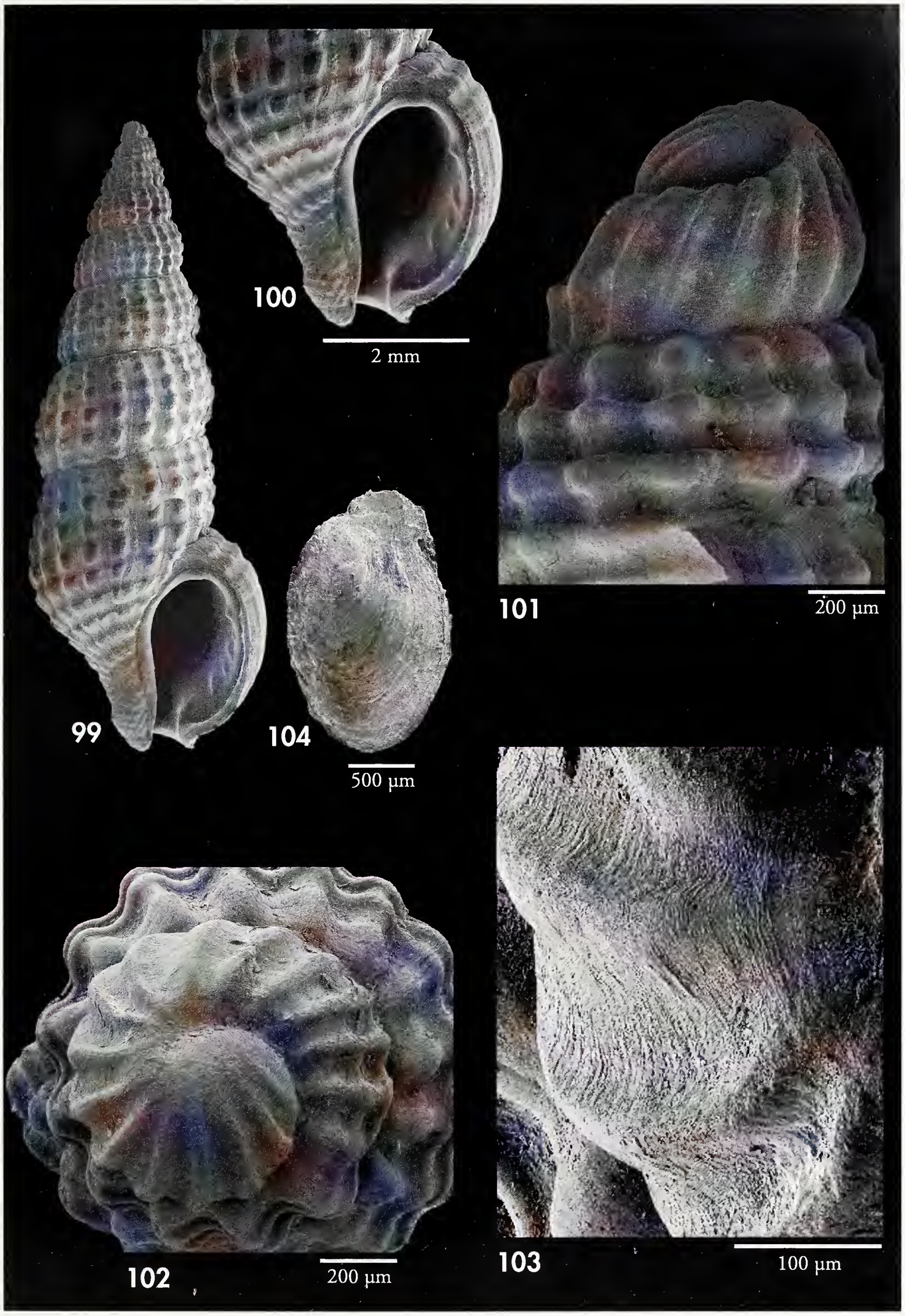
Chauvetia joani spec. nov. (Figs. 24-33, 71, 121-127, 182, 187)

Material tipo: Holotipo (Fig. 121) in MNCN (15.05/47526). Paratypes en las siguientes colecciones: AMNH (5), BMNH (20080490) (5), MNHN (5, Fig. 122), USNM (5), CJH (5), CPR (3), CDO (10), CJP (300 sp). Todos ellos de la localidad tipo. Otros paratipos: Les Madeleines: 7 ej, 7-13 m (CJP); Cap Vert Thiouriba: 6 ej, 33 m (CJP); Les Blockaus: 28 ej, 10-17 m (CJP); Somone: 2 ej, (CJP); Cap Vert: 7 ej (CJP); Takh Mon Khar: 2 ej, 35 m (CJP); Presquel'ile du Cap Vert: 1 ej, 5-40 m (CJP); Sable coquilles Cap Vert (09/1995): 7 ej (CJP); Sable coquilles Cap Vert (09/1995): 5 ej (CJP); Pecio del "Tacoma": 198 ej, 15 m (CJP); Les Blockaus: 4 ej, 10-17 m (CJP); Grand Thiouriba: 8 ej, 40 m (CJP); Presquel'ile du Cap Vert (9/98): 5 ej, 5-40 m (CJP); Grand Thiouriba, 1 ej, 40 m (CJP); 4 ej (CJP); Gouye Teni'M both: 3 c, 7 j, 25 m (CJP); Cap Vert, Pecio del "Tiwa": 6 ej, 35 m (CJP); Les Madeleines: 1 c, 6 j, 7-13 m (CJP); Cap Vert: 12 ej, 0-40 m (CJP); Charbonieres : 11 ej, 34 m (CJP); Senegal (sin precisar): 2 ej (CJP); Seminole: 3 c, 38 m (MNHN); Madeleines: 2 c, 16 j (C. sp. 1b) 18 m (MHNS); Gorée: 12 ej (sp.b) 20-40 m (MHNS); Gorée: 7 c, 3 j, 1 f, 6 m (MHNS); Pecio del "Tacoma": 50 c, 90 j, 15 m (MHNS); Cap Vert: 34 ej and j, 33 m (MHNS); Cap Vert: 6 ej, 13 m (MHNS); Grand Thouribe: 10 ej, 30 m (MHNS); Grand Thiouriba: 5 c, 2 j, 40 m. Lotes en alcohol: Hotel Oceanium (5D2-15): 5 ej, 6 m (MHNS): frente H. Oceanium, dragado (7D2-25): 4 ej, 20 m (MHNS); 1 ej, Almadies (10D2-8): 1 ej, 1 m (MHNS); Puerto de Gorée: 11 c, 6 m (MNHN); Gorée, costa sur (13D2-9): 18 ej, 10 m (MHNS); Sur de Gorée: 2 c, 25 m (MNHN); Este de Gorée: 1 c, 6 m (MNHN); Hotel Oceanium (7DK03-9): 3 ej, 5 m (MHNS); Gorée (8DK3-7): 2 ej, 6 m (MHNS); Dakar: 7 ej, 20 m (MHNS); Dakar: 2 ej, 30 m (MHNS); Gorée, costa sur (13D2-8): 1 ej, 15 m (MHNS); Bahía de Gorée: 2 c, 15 m (MNHN); 50 c, 5-15 m (MNHN); Dakar: 5 ej, (MHNS); 1 ej, (7D3-9 y 10) (MHNS); 1 c (MNHN); 1 c, 14°27N 17°33W, 170-200 m (MNHN); 2 c, 46-50 m (MNHN); Diago: 1 c, 19° 12′ N, 16° 26′ W, 6 m (MNHN); Bahía de Saloum: 1 c, 13° 57′ N, 17° 15′ W, 50 m (MNHN); entre Gorée y Dakar: 50 c (MNHN).
Otro material estudiado: Mauritania, Baie de l'Etoile: 1 j (dudoso). Senegal, al Sur de M'Bao: 2 s (en malas condiciones) (MNHN); Dakar: 11 c (mal estado) (MNHN).
Localidad tipo: Cap Vert "Tacoma", Bahía de Dakar, Senegal, 13 m.
Etimología: El nombre específico se dedica a Joan Daniel Oliver, hijo del primer autor, por su constante colaboración.

Descripción: Concha (Figs. 24-33, 121, 122) oblongo-fusiforme con unas seis vueltas de espira, sólida y una dimensión máxima de 7,9 mm.

Protoconcha (Figs. 124-126) con 1 vuelta de espira y 575 μm de anchura (núcleo: 215 μm; primera media vuelta: 425 μm) y 470 μm de altura. Escultura formada por una veintena de cordones espirales, planos, que en ocasiones se interrumpen o se inician antes de llegar al final. Los cordones suelen variar algo de anchura y son apenas algo más anchos que los interespacios. En los surcos que separan los cordones se observan micropliegues axiales que le dan un aspecto en forma de casillas. Al final de la protoconcha aparecen unas cinco o seis costillas axiales que se van separando progresivamente a medida que se hacen más relevantes.

Teleoconcha con cuatro cordones espirales a su inicio. El superior, tan solo forma el reborde inferior de la sutura, mientras que los tres inferiores suelen tener una anchura similar. Pronto el cordón superior se separa de la sutura y aparece por encima un quinto cordón espiral. La anchura de estos dos cordones subsuturales siempre es menor que la de los tres inferiores. La última vuelta representa en torno al 55% de la altura total de una concha adulta. En ella, hay seis cordones por encima de la inserción labial. Los cuatro inferiores son evidentes si bien el superior de estos suele ser más estrecho. Los dos superiores son de una menor anchura y menos evidentes. Los interespacios son de una anchura similar a la de los cordones espirales. Hay entre diez y doce costillas en cada vuelta de espira medianamente elevadas y cuya anchura, al principio es similar a los interespacios, pero luego se separan más y, por tanto, tienen menor anchura que sus interespacios. Las costillas axiales elevan los cordones espirales que pasan sobre ellas, haciéndolos más prominentes y dando la impresión de que son más claros. La base presenta de



Figuras 99-104. *Chauvetia tenuisculpta* (Dautzenberg, 1891). 99: concha, 10,5 mm; 100: detalle de la abertura; 101, 102: protoconcha; 103: detalle de la microescultura de la protoconcha; 104: opérculo.

Figures 99-104. Chauvetia tenuisculpta *(Dautzenberg, 1891). 99: shell, 10.5 mm; 100: detail of the aperture; 101, 102: protoconch; 103: detail of the microsculpture of the protoconch; 104: operculum.*

diez a once cordones espirales que van aproximándose y estrechándose en el canal sifonal. Microescultura de líneas espirales (Fig. 127) sólo apreciable con grandes aumentos.

Abertura (Fig. 71, 123) oval, representando algo menos del 40% de la concha adulta (entre el 35 y el 38 %). El labio externo es más abierto que en otras especies de *Chauvetia* y presenta seis dientes en su cara interna, siendo el inferior el inicio del canal sifonal. Éste es muy corto y está inclinado hacia la derecha, siendo esta una característica típica de la especie.

Color castaño oscuro o castaño-amarillento en la mayoría de las conchas estudiadas. Algunas son de color uniforme pero en muchas otras los cordones son más claros que el fondo, lo que le da un aspecto lineado. Algunas conchas son de color amarillento más claro, con una banda rojiza subsutural y otra en la base de la concha. Hay también ejemplares completamente blancos. Dos de los ejemplares examinados eran de color marrón oscuro con la base blanca.

Dimensiones: el holotipo tiene unas dimensiones de 5,4 x 2,3 mm; los ejemplares mayores llegan hasta 7,9 milímetros de altura y 2,7 de anchura.

Animal blanquecino con manchas y puntos blanco-leche. El sifón y los tentáculos son ligeramente amarillos con puntos blancos y el pie es casi blanco con puntos opacos blanco-leche. Opérculo (Fig. 182) ovoide, con núcleo subcentral.

Rádula (Fig. 187) muy pequeña y alargada, con más de 160 filas de dientes, central rectangular con una cúspide, y lateral con tres, curvadas hacia dentro.

Distribución: Desde Mauritania a Dakar, entre 0 y 40 m.

Discusión: Es con mucho la especie más abundante en la zona estudiada.

MICALI (1999, figs. 8 y 9) ilustra dos conchas procedentes de Senegal, que menciona como *Chauvetia* sp. 1; estas conchas podrían corresponderse con la presente especie. Las fotografías presentadas así lo hacen suponer, si bien algunos detalles dados en la descripción, como la altura de 10 mm, la proporción de la altura de la última vuelta o el número de cordones en esta vuelta (de 25) serían más cuestionables.

La diferenciación se debe hacer con las siguientes especies:

Chauvetia brunnea (Donovan, 1804) de Europa, es más pequeña en tamaño pero sus cordones espirales son más anchos que en *Chauvetia joani* spec. nov. En el caso de los juveniles, se distinguirían por tener un cordón menos en la última vuelta y un canal sifonal más vertical que en *C. joani*.

Chauvetia tenebrosa spec. nov. tiene una concha más pequeña, menos aguzada, la protoconcha es más pequeña y con escultura entre los cordoncillos más marcada.

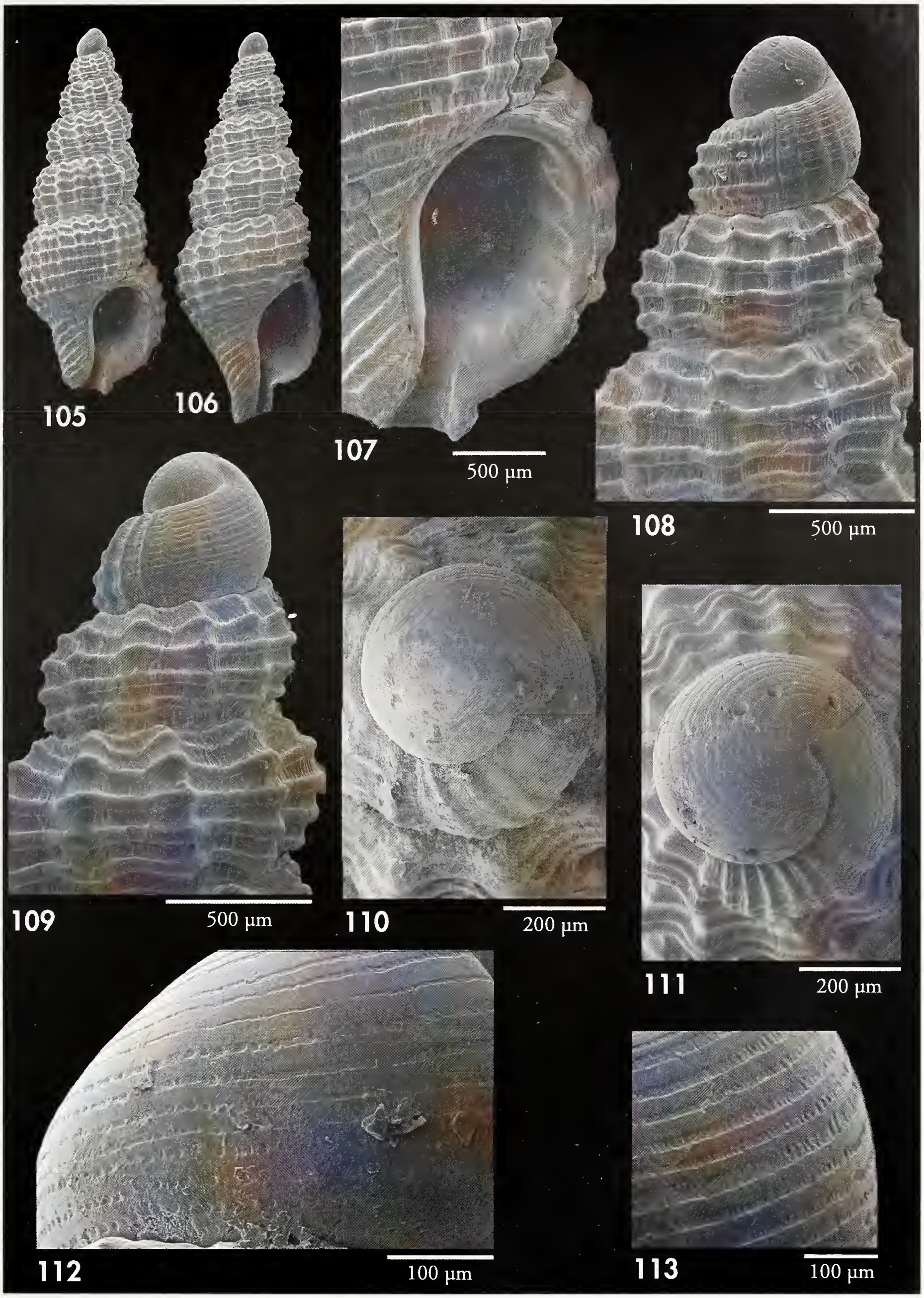
Chauvetia procerula Monterosato, 1889 tiene el canal sifonal más claro, las costillas más pronunciadas y menos numerosas; la abertura más pequeña y la protoconcha con menor número de cordones espirales

Chauvetia mamillata Risso, 1826 tiene el canal sifonal vertical, no inclinado; La abertura bucal es más cerrada y las costillas axiales son más pronunciadas y menos numerosas; la abertura más pequeña y protoconcha con menor número de cordones.

Chauvetia pardacuta spec. nov., ver más adelante, en el apartado de Comentarios de esta especie.

Chauvetia pelorcei spec. nov. (Figs. 34-38, 72, 128-133)

Material tipo: Holotipo (Fig. 128) en MNCN (15.05/47527). Paratipos en las siguientes colecciones: AMNH (1), BMNH (20080491) (1), MNHN (1), MHNS (10), USNM (1), CJH (1), CDO (1), CPR (1), CJP (18), todos de la localidad tipo. Otros paratipos: Senegal: Dakar: Madeleines: 18 c, 4 j, 3 f, 18 m (MHNS); Grand Thouribe: 1 ej, 18-30 m (MHNS); Gorée: 1 c, 1 j, 1 f, 20-40 m (MHNS); Pecio del "Tacoma": 10 ej, 15-18 m (MHNS); Cap Vert: 3 c, 1 j, 18-33 m (MHNS); Cap. Vert: 3 ej, 13-18 m (MHNS); Cap Vert, Petit Thiouriba: 14 ej, 33 m (CJP); Presqu'ile Cap Vert (09/98): 41 ej, 35 m (CJP);



Figuras 105-113. *Chauvetia lamyi* Knudsen, 1956. 105: concha con el patrón claro de color, 5,4 mm; 106: concha con patrón oscuro de color, 5,8 mm; 107: detalle de la abertura; 108, 110; protoconcha, de concha clara; 109, 111; protoconcha, de concha oscura; 112, 113: detalle de la microescultura de la protoconcha.

Figures 105-113. Chauvetia lamyi *Knudsen, 1956. 105: shell with the pale colour pattern, 5.4 mm; 106: shell with a dark colour pattern, 5.8 mm; 107: detail of the aperture; 108, 110; protoconch, of a pale shell; 109, 111; protoconch, of a dark shell; 112, 113: detail of the microsculpture of the protoconch.*

Cap Vert, pecio del "Tacoma" (30/08/98): 5 c, 1 j, 13 m (CJP); Cap Vert (arena conchífera) (09/1995): 2 c, 3 j (CJP); Pecio del "Tacoma" : 2 c, 10 j, 15 m (CJP); Grand Thiouriba: 45 ej, 40 m (CJP); Les Madeleines: 2 c, 4 j, 7-13 m (CJP); Grand Thiouriba: 4 ej, 40 m (CJP); Gouye Temi' Mboth: 3 c, 3 j (CJP); Cap Vert: 6 ej, 0-40 m (CJP); Charbonier: 1 ej, 34 m (CJP); 1ej, Bahía de Dakar, dragado (7D2-10): 1 ej (MHNS); Cap Vert: 4 ej (CJP); 4 c, 29 j, sedimentos entre 20-40 m (MHNS); SW Cap Manuel: 1 c, 50 m (MNHN).

Otro material estudiado: Varios ejemplares de la localidad tipo fueron disueltos para estudio radular.

Localidad tipo: Cap Vert, pecio del "Tiwa", Bahía de Dakar, Senegal, 38 m.

Etimología: El nombre específico se dedica al malacólogo Jacques Pelorce, de Paris, por su importante aportación de material a este trabajo.

Descripción: Concha (Figs. 34-38, 128) oblongo-fusiforme, sólida, con unas seis-siete vueltas de espira y unas dimensiones máximas de unos 4,7 mm.

Protoconcha (Figs. 130, 131) con 0,8 vueltas y una anchura de 475 μm de (núcleo: 200 μm y primera media vuelta: 370 μm) y 525 μm de altura, ornamentada por cordoncillos espirales (una docena en su tramo final) que tiene, por lo general, una anchura similar a la de sus interespacios. Al final de la protoconcha aparecen dos o tres costillitas axiales rectas. La microescultura de los espacios entre estos cordoncillos (Figs. 132, 133), muestra un cruzado muy irregular entre lineas espirales y axiales.

Teleoconcha con unas seis vueltas, convexas y por lo general angulosas, la sutura ondulada y profunda. Cordones espirales y costillas axiales, al cruzarse, forman tubérculos nodulosos algo sobresalientes. La teleoconcha se inicia con tres cordones espirales y, por encima, hay un cuarto cordón que aparece como un reborde subsutural. En la penúltima vuelta hay cinco cordones, de los cuales, los dos superiores tienen notablemente menor anchura. De los tres inferiores, el más ancho es el central y, por lo tanto, el más prominente. En muchas conchas ese cordón confiere al perfil de la espira un aspecto anguloso. Los cordones son claramente más anchos que sus interespacios y, al ser de color claro, contrastan con el fondo rojizo de aquellos. La última vuelta representa el 58% de la altura total y, en ella, hay cinco cordones por encima de la inserción labial siendo los dos superiores muy estrechos e incluso el superior puede desaparecer. Por debajo de la inserción labial aparecen de diez a once cordones, más anchos que sus interespacios y que se van juntando en el canal sifonal. Hay unas diez costillas en cada vuelta casi tan anchas como sus interespacios y que al cruzarse con los cordones originan tubérculos más o menos prominentes.

Abertura (Figs. 72, 129) redondeada, representa el 40 % de la altura total, con seis dientes en el interior del labio externo. Canal sifonal corto pero evidente.

Color de la concha rojizo con cordones algo más claros, que al ser más anchos que los interespacios, le dan un aspecto lineado. La base de la concha y el canal sifonal son rojizos.

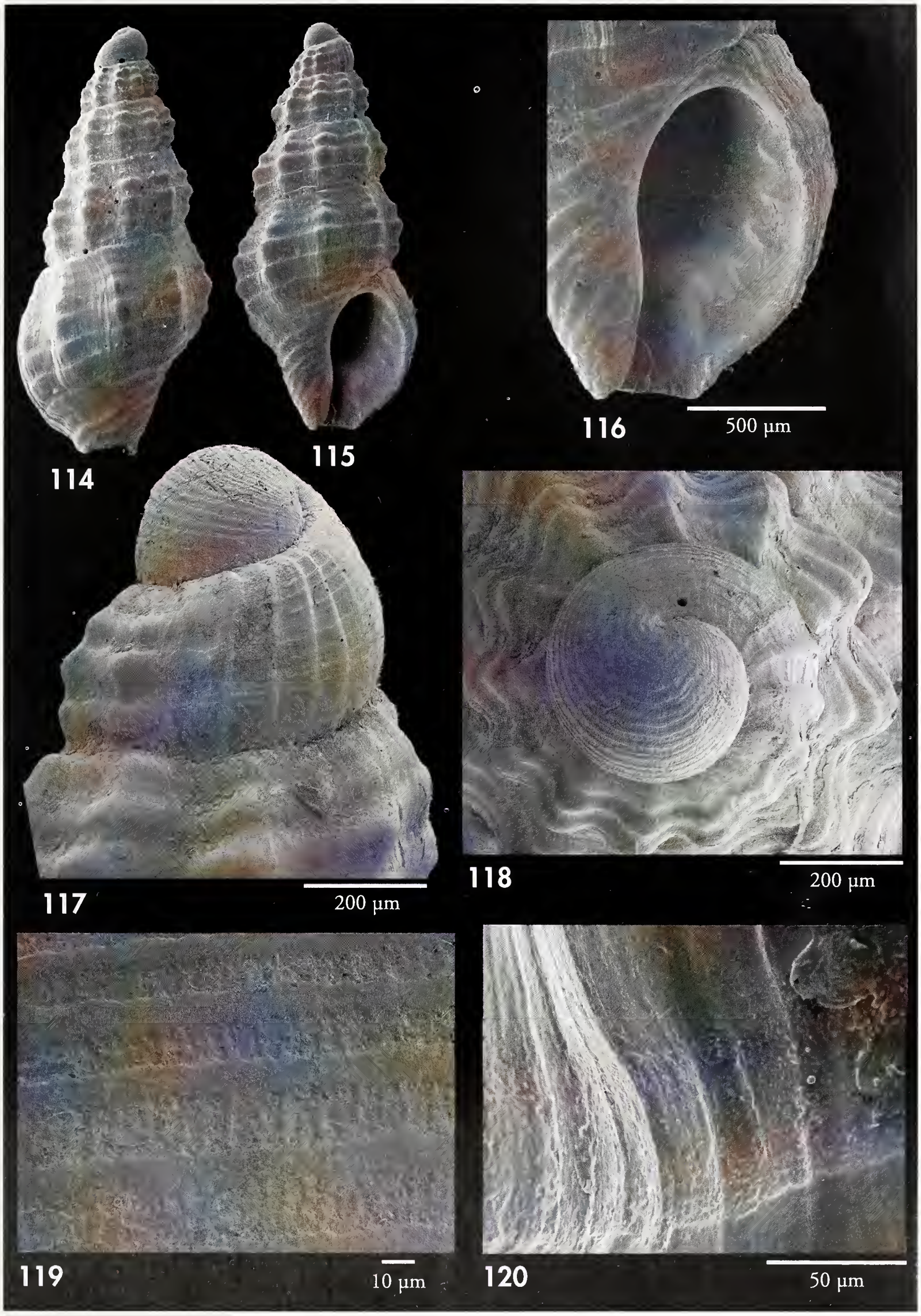
Dimensiones: El holotipo tiene 4,5 x 2,6 mm.

Animal de color crema con puntos blanco-leche. Zona oscura en el dorso respetando la parte anterior del pie. Algunas manchas en el dorso del sifón.

Distribución: Sólo conocida de Dakar entre 5 y 40 metros.

Comentarios: Las conchas de esta especie pueden tener un perfil de espira más o menos uniformemente convexo o angular en función de la prominencia de los cordones espirales.

En el área estudiada no hay especies morfológicamente semejantes. La que aparentemente parecería más similar sería *C. guinchiorum* Micali, 1999, del Mediterráneo, que guarda cierto semejanza, sobre todo en el aspecto cromático, por el contraste de los anchos cordones claros con el fondo de concha rojizo. Esta especie mediterránea parece ser una especie muy local y su área de distribución se limita a las costas italianas, por lo



Figuras 114-120. *Chauvetia tenebrosa* spec. nov. 114: paratipo, 3,7 mm (MNHN); 115: holotipo, 3,6 mm (MNCN); 116: detalle de la abertura; 117, 118; protoconcha; 119; detalle de la microescultura de la protoconcha; 120: detalle de la microescultura de la teleoconcha.

Figures 114-120. Chauvetia tenebrosa *spec. nov. 114: paratype, 3.7 mm (MNHN); 115: holotype, 3.6 mm (MNCN); 116: detail of the aperture; 117, 118; protoconch; 119; detail of the microsculpture of the protoconch; 120: detail of the microsculpture of the teleoconch.*

que geográficamente sería poco probable esa dispersión para una especie de protoconcha paucispiral y posiblemente lecitotrófica, con poca capacidad de dispersión. Según el trabajo de descripción original, y un ejemplar que se ha podido comparar (CAP), la protoconcha de *C. giunchiorum* es más alta y más ancha, con unos 20 cordoncillos espirales, la coloración es algo diferente, con color blanco de fondo y cordoncillos castaños muy finos en los interespacios, y con una base de color blanco; además, tendría más costillas axiales al final de la protoconcha.

Chauvetia pardofasciata spec. nov. (Figs. 39-44, 73, 134-143)

Material tipo: Holotipo (Fig. 134) in MNCN (15.05/47528). Paratipos en las siguientes colecciones: AMNH (1), BMNH (20080486) (1), MNHN (1), MHNS (1), USNM (1), CDO (1), CJH (1), CPR (1), todos procedentes de la localidad tipo. Otros paratipos: Senegal: Dakar: Madeleines: 1 c, 1 j, 18 m (MHNS); Gorée: 18 ej, 20-40 m (MHNS); 3 c (MNHN); Gorée: 1 c, 1 j, 1 f, 6 m (MHNS); entre Dakar y Gorée: 4 c, dragado 20-30 m (MHNS); Pecio del "Tacoma": 2 ej, 15 m (MHNS); Cap Vert: 1 ej, 13 m (MHNS); Petit Corniche, Cap Vert: 10 ej, 5 j, 3-7 m (CJP); Cap Vert (09/96): 1 j, N'Both, 6-7 m (CJP); 2 ej, 5-40 m (CJP); Grand Thiouriba: 1 c, 20 m (CJP); Gouye Temi' M'Both: 6 c, 1 j (CJP); 3 ej, (8D3-7) (MHNS); 2 ej, (10D2-9) (MHNS); 15 c, 19 j, sedimentos de la bahía, entre 20-40 m (MHNS).
Otro material estudiado: Dos conchas de la localidad tipo fueron destruidas para estudio radular.
Localidad tipo: Gorée, Bahía de Dakar, Senegal, 20-40 m.
Etimología: El nombre específico hace alusión a las bandas castañas que presenta la concha, en su forma más habitual.

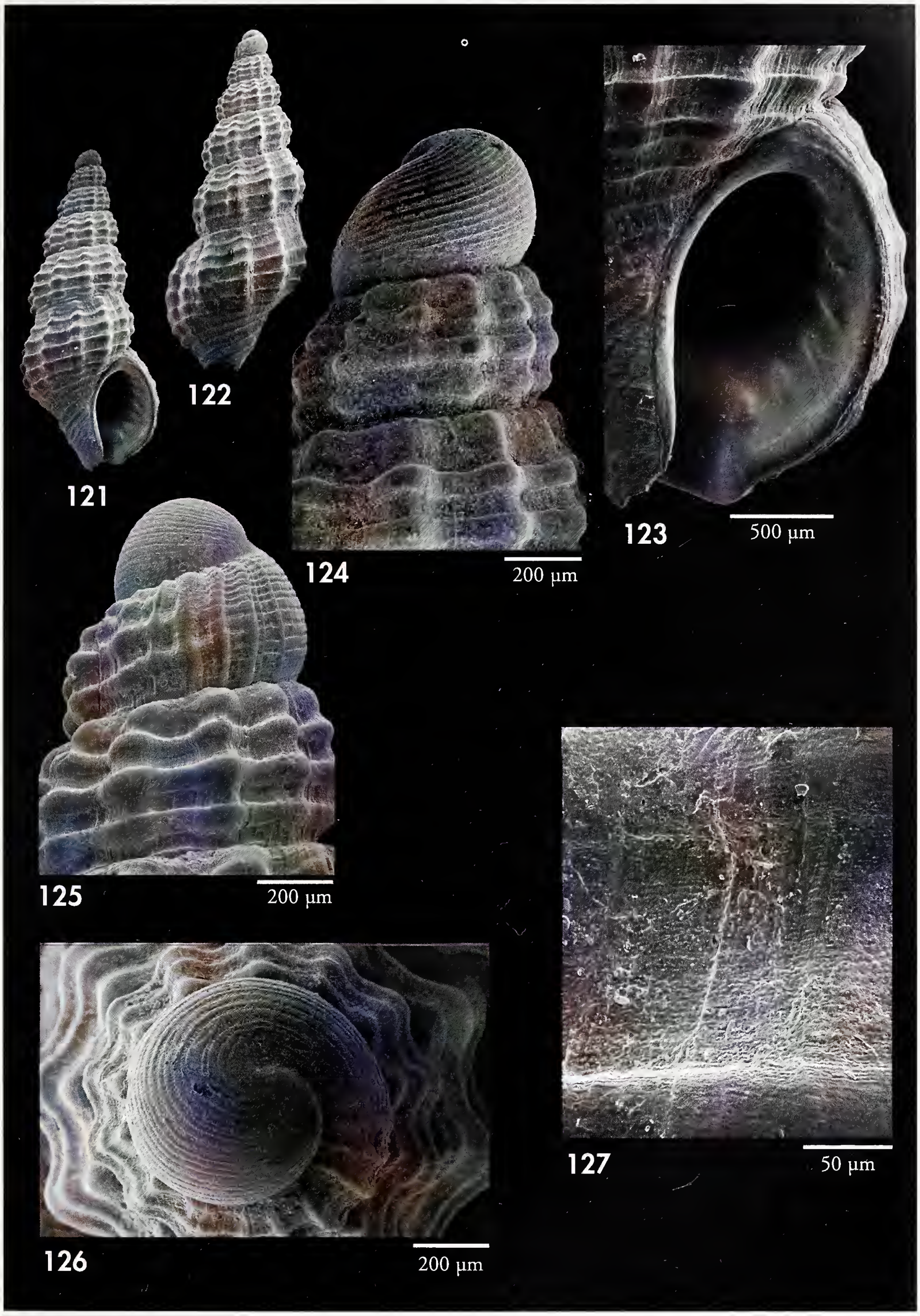
Descripción: Concha (Figs. 39-44, 134, 135) pupoide, sólida, con unas cinco vueltas de espira, y llegando a alcanzar hasta 4.0 mm de altura.

Protoconcha (Figs. 136-139) paucispiral, con 0.8 vueltas de espira y que alcanza 515 μm de altura y 475 de anchura (núcleo: 240 μm, y primera media vuelta: 440 μm). Ornamentada por una quincena de cordones al final de la protoconcha más o menos de la misma anchura y equidistantes, separados por surcos con una estriación axial (Figs. 140, 141). La anchura de los cordones es algo mayor que la de los interespacios, aunque en el inicio de la protoconcha estos cordones pueden ser menos anchos que sus interespacios, en los que se pueden observar las típicas incisiones axiales de muchas protoconchas de *Chauvetia*. Al final de la protoconcha, hay tres o cuatro costillas verticales, algo opistoclinas. La parte superior de las costillas se curva formando una estrecha repisa subsutural sólo visible con el microscopio electrónico de barrido.

Teleoconcha que se inicia con tres cordones espirales de los que el superior aparece como un mero reborde de la sutura, aunque pronto se separa. En la última vuelta hay cuatro cordones por encima de la inserción labial de los que el superior es claramente más estrecho. En la base de la concha hay nueve cordones al principio separados regularmente pero que se juntan en el canal sifonal. Los cordones prácticamente tienen la misma anchura que los interespacios. En estos se observa una microescultura espiral (Figs. 142, 143) en forma de microcordoncillos. Hay una docena de costillas de anchura similar a los interespacios que, al cruzarse con los cordones espirales, originan tubérculos redondeados, algo elevados. La última espira ocupa el 66% de la altura total.

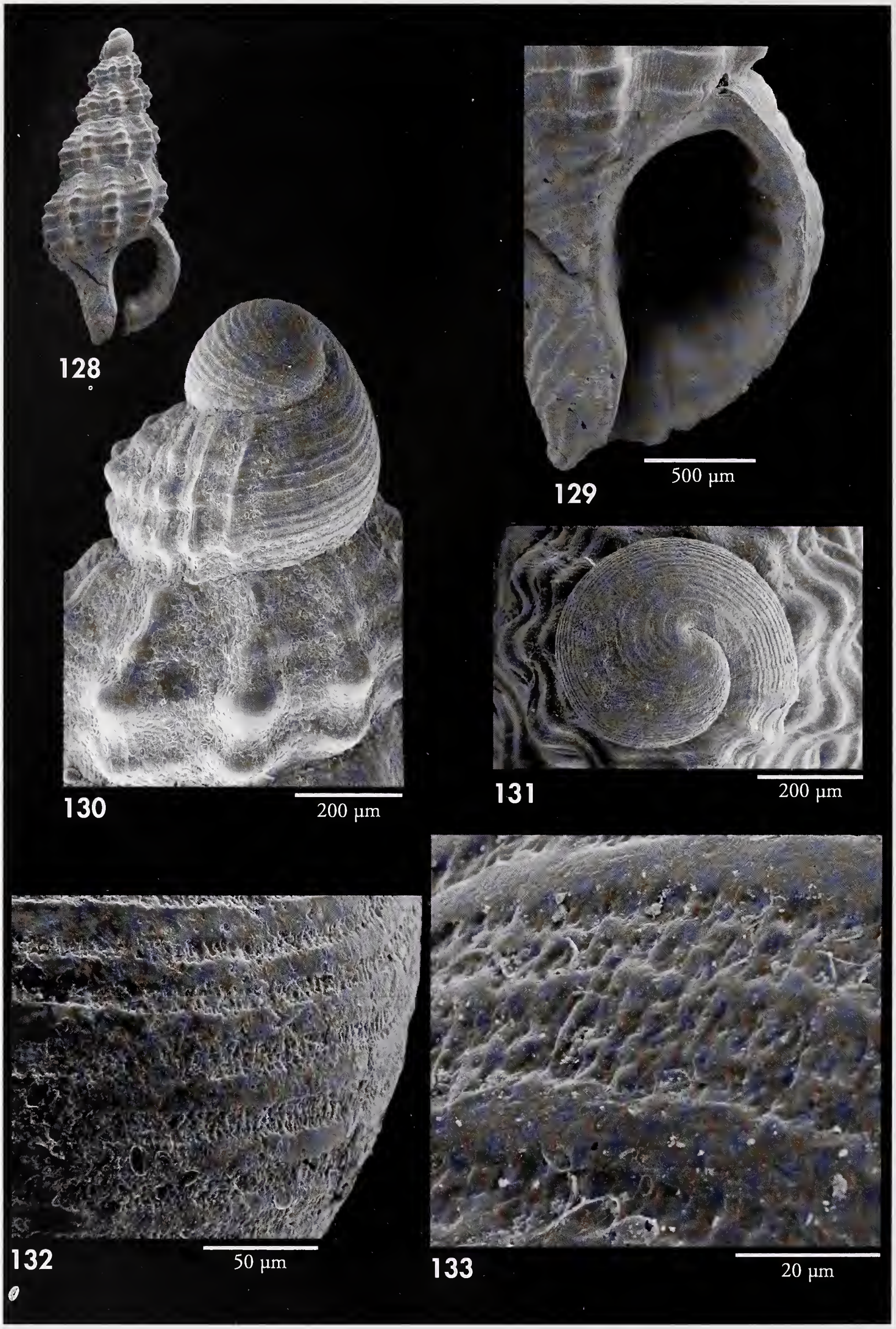
Abertura (Figs. 73) ligeramente oval, representando el 44% de la altura total de la concha. Canal sifonal corto, no muy abierto y poco marcado. Cinco dientes en el interior del labio externo.

Color de la concha, blanco, con los cordones inferiores de color marrón rojizo, mientras el subsutural también es blanco. En la última vuelta, también es blanco un nuevo cordón más pequeño que aparece por encima del subsutural; también son blancos los últimos de la base. Algunas conchas son totalmente

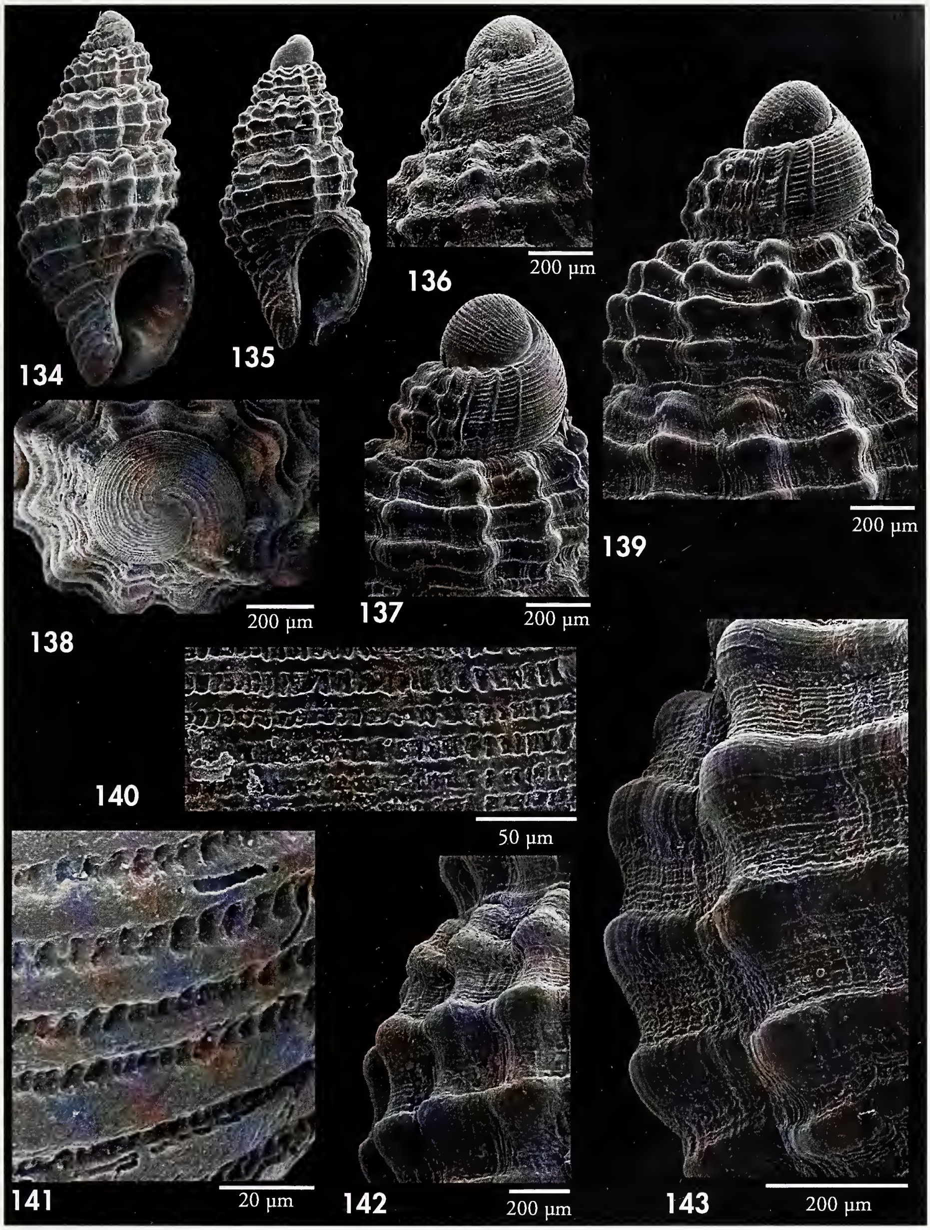


Figuras 121-127. *Chauvetia joani* spec. nov. 121: holotipo, 5,4 mm (MNCN); 122: paratipo, 5,8 mm (MNHN); 123: detalle de la abertura; 124-126: protoconcha; 127: detalle de la microescultura de la teleoconcha.

Figures 121-127. Chauvetia joani *spec. nov. 121: holotype, 5.4 mm (MNCN); 122: paratype, 5.8 mm (MNHN); 123: detail of the aperture; 124-126: protoconch; 127: detail of the microsculpture of the teleoconch.*



Figuras 128-133. *Chauvetia pelorcei* spec. nov. 128: holotipo, 4,7 mm (MNCN); 129: detalle de la abertura; 130, 131: protoconcha; 132, 133: detalle de la microescultura de la protoconcha.
Figures 128-133. Chauvetia pelorcei *spec. nov. 128: holotype, 4.7 mm (MNCN); 129: detail of the aperture; 130, 131: protoconch; 132, 133: detail of the microsculpture of the protoconch.*



Figuras 134-143. *Chauvetia pardofasciata* spec. nov. 134: holotipo, 3,8 mm (MNCN); 135: paratipo, forma blanca, 3,0 mm (MNHN); 136-138: protoconcha, forma con bandas; 139: protoconcha, forma blanca; 140; detalle de la microescultura de la protoconcha, forma blanca; 141; detalle de la microescultura de la protoconcha, forma con bandas; 142: detalle de la microescultura de la teleoconcha, forma con bandas; 143: detalle de la escultura de la teleoconcha, forma blanca.
Figures 134-143. Chauvetia pardofasciata *spec. nov. 134: holotype, 3.8 mm (MNCN); 135: paratype, white morph, 3.0 mm (MNHN); 136-138: protoconch, banded morph; 139: protoconch, white morph; 140; detail of the microsculpture of the protoconch, white morph; 141; detail of the microsculpture of the protoconch, banded morph; 142: detail of the microsculpture of the teleoconch, banded morph; 143: detail of the microsculpture of the teleoconch, white morph.*

blancas, sin ninguna traza de castaño. La protoconcha es blanca, aunque a veces tiene un ligero color violáceo.

Dimensiones: el holotipo mide 3,8 x 1,8 mm.

Animal de color blanco lechoso, sifón casi transparente y con aislados puntos blanco leche.

Distribución: Conocida del área de Dakar, entre 3 y 40 m.

Comentarios: La forma con bandas tiene una aparente similitud con *C. soni*, pero se diferencia porque esta última especie es más grande, la protoconcha más ancha, y en el patrón de color tiene dos bandas castañas marcadas pero, en la última vuelta, por encima y por debajo, hay dos bandas muy finas (a veces sin color), y en la zona basal, también hay bandas castañas muy finas. En la protoconcha, después de la zona sin escultura axial aparecen a lo largo de media vuelta unas 12-13 costillas axiales fuertes. La microescultura de la protoconcha en *C. soni*, tiene entre los cordones, una serie de filetes dispuestos muy irregularmente, al contrario de lo que ocurre en *C. pardofasciata*.

Las conchas con coloración blanca, se podrían confundir a primera vista con las de *C. robustalba* spec. nov. pero estas son más grandes, más estrechas y con el ápice de color castaño, y tienen aislados puntos castaños en la teleoconcha.

Las dos formas, blanca y con bandas castañas, no son absolutamente definidas en una u otra variedad, ya que hay ejemplares con formas intermedias.

Chauvetia javieri spec. nov. (Figs. 45-48, 74, 144-151)

Chauvetia sp. 1. Micali, 1999. *Bol. Malac.*, 34: 66, figs. 8, 9.

Material tipo: Holotipo (Fig. 144) en MNCN (15.05/47529). Paratipos en las siguientes colecciones: Cap Vert: 1 ej, (exCJP) (MNHN); Gorée: 1 c (Fig. 145), 1 ej, 3 j, 1 f, 15 m (MHNS); 3 c, 14ºN 17º2'W, 50 m (MNHN); Pecio del "Tacoma": 2 c, 1 ej, 30 m (CJP); Pecio del "Tacoma": 1 c, 15 m (BMNH 20080488); Bahía de Dakar: 1 ej, 20 m (MHNS); sur de Gorée: 2 c, 32-34 m (MNHN); 8 c, 39 m (MNHN); 1 c, 30-40 m (MNHN); 5 c, 42 m (MNHN); Seminole: 17 c, 38 m (MNHN); Bahía del Saloum: 6 c, 50 m (MNHN).

Otro material estudiado: Senegal: Dakar: Gorée: 2 j, dudosos (MHNS); sur de Cap Manuel: 4 c (deterioriadas), 50 m (MNHN).

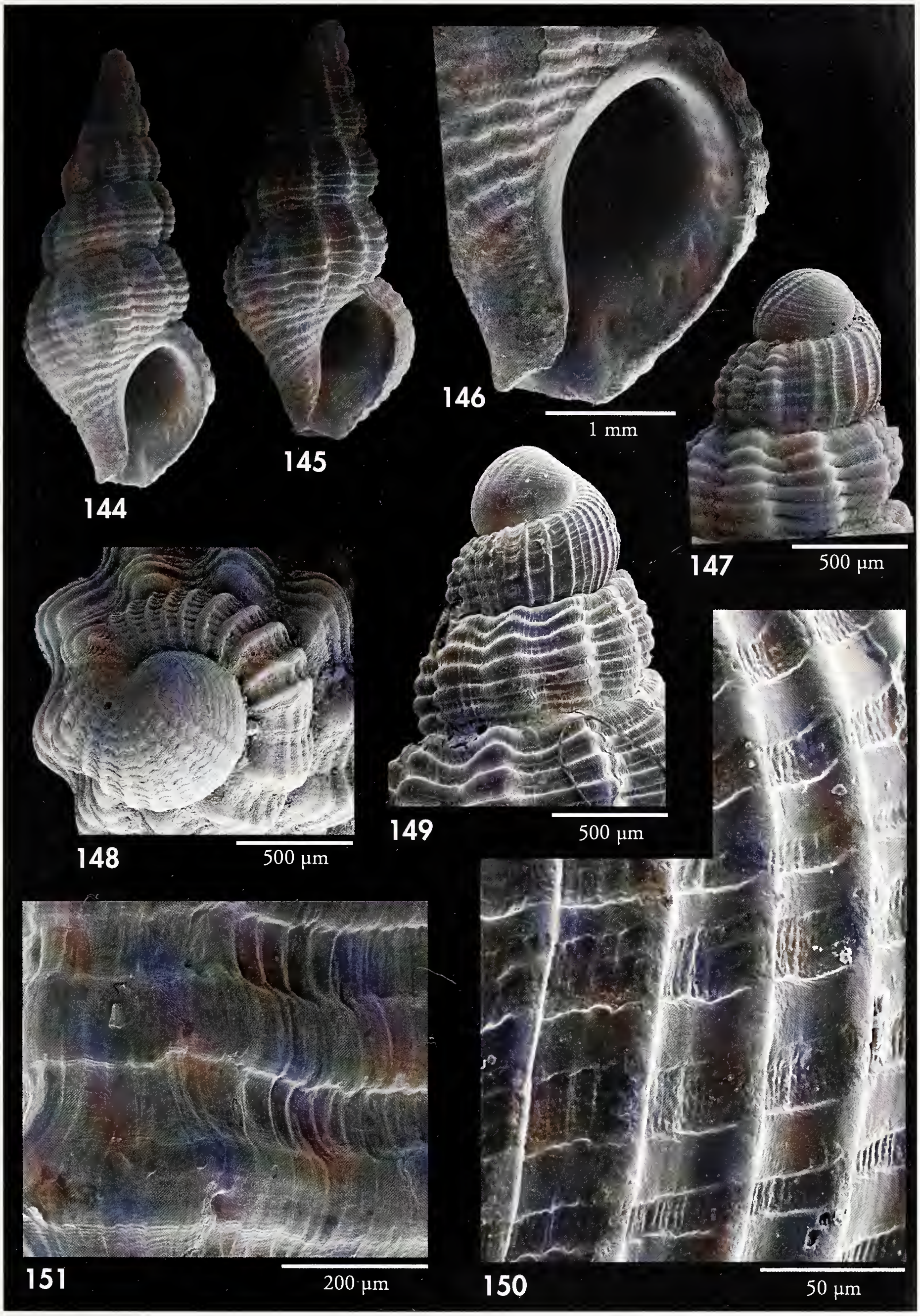
Localidad tipo: Cap Vert, Pecio del "Tacoma", Bahía de Dakar, Senegal, 30 m.

Etimología: El nombre de esta especie se dedica a Javier Oliver, hijo del primer autor, por su constante colaboración.

Descripción: Concha (Figs. 45-48, 144, 145) fusiforme, sólida, con unas siete vueltas de espira y una dimensión máxima de 7,8 mm.

Protoconcha (Figs. 147-149) con 1,1 vueltas y 775 μm de anchura (núcleo: 410 μm y primera media vuelta: 570 μm) y unas 730 μm de altura. Está ornamentada por cordones planos, de anchura variable pero claramente más anchos que los interespacios. En el tramo final de la protoconcha se observan de doce a quince cordoncillos. En los interespacios se observan las típicas incisiones, aunque más continuas que en otras especies de *Chauvetia*. Hay una importante escultura axial formada por más de una veintena de costillitas que se inician a partir del núcleo y que van ganando en relevancia a medida que se acercan al final de la protoconcha; son prácticamente ortoclinas y rectas aunque se curvan muy ligeramente en su parte más alta.

Teleoconcha con vueltas convexas y sutura profunda y ondulada. Las vueltas están ornamentadas por cordones espirales y costillas, ambos más anchos que sus respectivos interespacios. En la cuarta vuelta, ya hay siete cordones que, en la última vuelta, se mantienen por encima de la inserción final de la espira y, en la parte basal, hay una docena más. En la última vuelta, la escultura axial está formada por diez o doce costillas



Figuras 144-151. *Chauvetia javieri* spec. nov. 144: holotipo, 7,6 mm (MNCN); 145: paratipo, 7,3 mm (MHNS); 146: detalle de la abertura; 147-149: protoconcha; 150, 151: detalle de la microescultura de la teleoconcha.

Figures 144-151. Chauvetia javieri *spec. nov. 144: holotype, 7.6 mm (MNCN); 145: paratype, 7.3 mm (MHNS); 146: detail of the aperture; 147-149: protoconch; 150, 151: detail of the microsculpture of the teleoconch.*

convexas y algo prosoclinas. Esta última vuelta representa el 56 % de la altura.

Abertura (Figs., 74, 146) oval, ocupando el 38% de la altura total de la concha. En la parte interna del labio externo se pueden observar unos diez dientecillos algo oblicuos, de los que el inferior es el mayor y forma el margen externo del canal sifonal, que es corto y ancho.

Color de la concha amarillento con base y canal sifonal rojizos. También hay tonalidades rojizas en el ápice y en la zona sutural.

Dimensiones: el holotipo mide 7,6 x 3,5 mm.

Animal con coloración blanca, con puntos blanco leche.

Distribución: Conocida de Senegal, se han encontrado conchas en las costas del Sahara y, probablemente, alguna ha sido referida en Canarias.

Comentarios: Esta especie tiene unos caracteres diferenciales muy claros, como son: las costillas axiales que se extienden por toda la protoconcha, y el número elevado de dientes en el labio externo.

C. tenuisculpta tiene costillas axiales en la protoconcha, pero tiene una concha más grande, de color blanco y con una escultura múy regular.

C. retifera Brugnone, 1880 también tiene una protoconcha muy similar a esta especie, aunque más alta, pero la concha tiene vueltas casi planas, sutura poco profunda y una coloración de bandas castañas con costillas axiales poco prominente y más numerosas.

C. joani spec. nov. se parece superficialmente, pero se diferencia en que tiene menos cordones espirales, menos dientes en la abertura, y sólo tiene costillas axiales en el final de la protoconcha.

Chauvetia robustalba spec. nov. (Figs. 49-52, 75, 152-159, 188)

Material tipo: Holotipo (Fig. 153) in MNCN (15.05/47530). Paratipos en las siguientes colecciones: Dakar: 1 c, (Fig. 152) (MNHN); 4 ej, 3 c (10D2-10) (MHNS); 2 ej (10D2-26) (MHNS); Cap Vert: 2 c, 15 m (CJP); 2 j, dragados en la bahía, 20-40 m (MHNS); Delta del Saloum: 2 c, 13° 57′ N, 17° 15′ W, 50 m (MNHN).

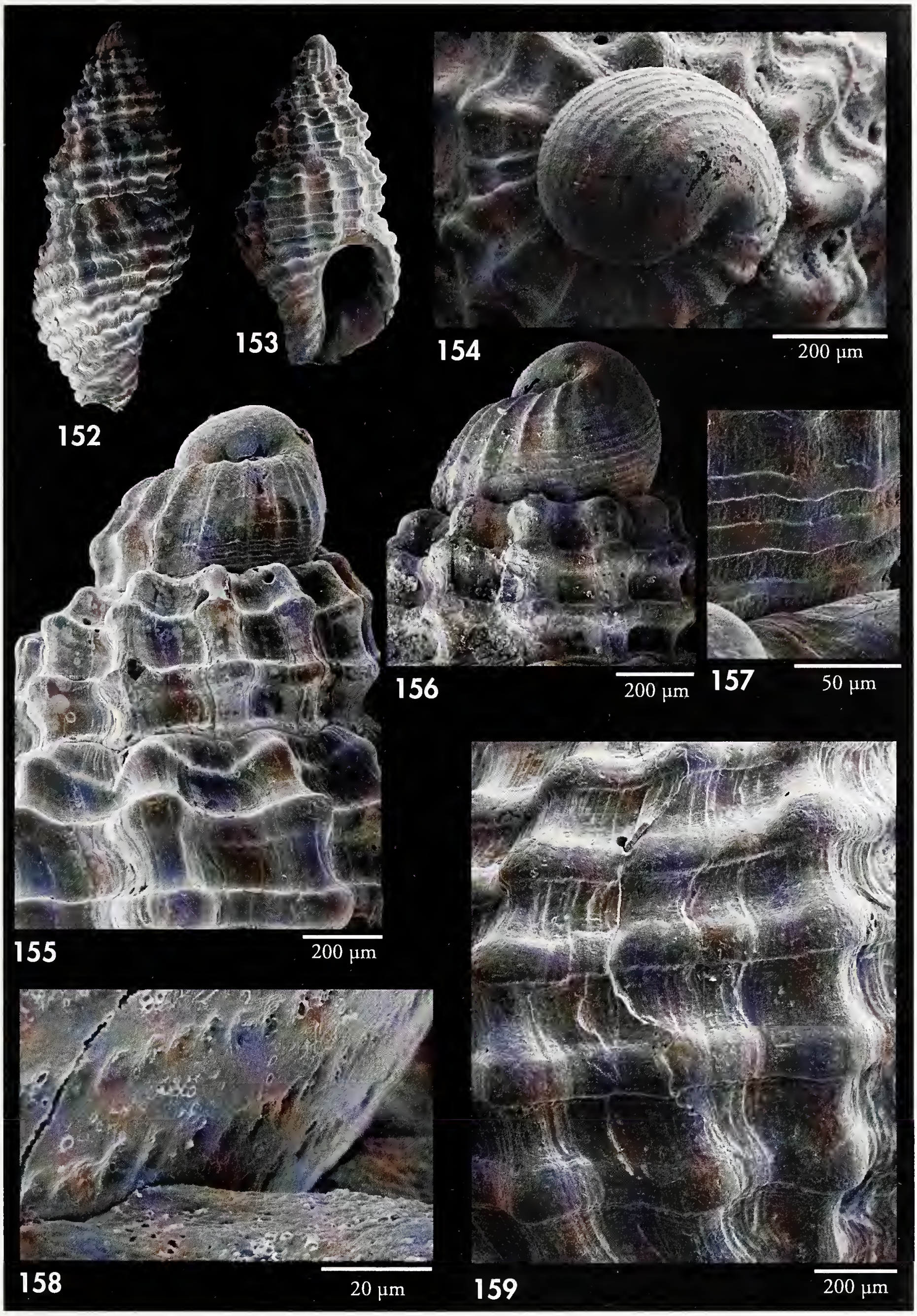
Localidad tipo: Bahía de Dakar, Senegal.

Etimología: El nombre específico proviene de la unión de dos palabras latinas "robusta" y "alba" que hacen alusión a dos de los caracteres de la concha, su robustez y su coloración.

Descripción: Concha (Figs. 49-52, 152, 153) fusiforme, gruesa y corta, sólida, con unas cinco vueltas de espira y unas dimensiones de hasta 5,4 mm.

Protoconcha (Figs. 154-156) con 0,6 vueltas de espira, el núcleo muy ancho (con 345 μm) y emergente, con unas 425 μm de altura y unas 475 μm de anchura. La escultura está formada por cordoncillos espirales, de los que hay unos 15 hacia el final. Los interespacios son irregulares aunque más anchos que los cordoncillos y en su interior existen incisiones axiales (Fig. 158). Al final de la protoconcha los cordones y los interespacios suelen tener una anchura similar (Fig. 157). La escultura axial está formada por unas cinco o seis costillas axiales, presentes hacia el final de la protoconcha.

Teleoconcha con unas 4 vueltas de espira escasas y escultura formada por cordones longitudinales y costillas axiales, algo prosoclinas y que, al cruzarse, forman nódulos evidentes (Fig. 159). La escultura espiral se inicia con dos cordones prácticamente de la misma anchura y un tercer cordón, en posición superior, que va apareciendo primero como un reborde subsutural y luego ya se puede observar a cierta distancia de la sutura, pero siendo siempre un poco más estrecho que los otros dos. En la última vuelta hay tres cordones por encima del punto de inserción del labio externo y que son algo más estrechos que sus interespacios. Un cuarto cordón se esboza en posición subsutural. En la base, hay ocho cordoncillos más que se van aproximando entre ellos a medida



Figuras 152-159. *Chauvetia robustalba* spec. nov. 152: paratipo, 5,2 mm (MNHN); 153: holotipo, 4,3 mm (MNCN); 154-156: protoconcha; 157, 158: detalle de la microescultura de la protoconcha; 159: detalle de la microescultura de la teleoconcha.
Figures 152-159. Chauvetia robustalba *spec. nov. 152: paratype, 5.2 mm (MNHN); 153: holotype, 4.3 mm (MNCN); 154-156: protoconch; 157, 158: detail of the microsculpture of the protoconch; 159: detail of the microsculpture of the teleoconch.*

que se acercan al canal sifonal, que es corto y ancho. La última vuelta representa el 64% de la altura de la concha y tiene unas quince costillas axiales, algo más estrechas que sus interespacios.

Abertura (Figs. 75) ligeramente ovalada con un canal sifonal corto y algo inclinado hacia la izquierda. Representa el 45% de la altura total de la concha. En el interior del labio externo se aprecian cinco dientes.

Color de la concha blanco-amarillento, pero la protoconcha y el inicio de la primera vuelta de teleoconcha son de color rojizo o castaño. También se pueden observar puntos rojizos irregularmente dispuestos en la superficie de la concha, preferentemente en la zona basal y en la última espira.

Dimensiones: el holotipo mide 4,3 x 2,1 mm.

Animal blanquecino, con un tono crema muy ligero por el dorso. Rádula (Fig. 188) con numerosas filas de dientes, el central rectangular con una cúspide, y los laterales con tres cúspides, curvadas hacia dentro.

Distribución: Sólo conocida de la Bahía de Dakar.

Comentarios: Por su forma corta, color claro con puntos rojizos, y protoconcha elevada con media vuelta de espira, esta especie no tiene ningún parecido con otras conocidas. La más parecida sería *C. pardofasciata* en sus formas sin color, pero, precisamente en estas formas, tiene una protoconcha blanca o ligeramente violácea, con el núcleo más pequeño y con menos vueltas que la de *C. robustalba*; además tiene una microescultura en los interespacios entre los cordones espirales.

Chauvetia luciacuestae spec. nov. (Figs. 53-55, 76, 160-168, 183)

Material tipo: Holotipo (Fig. 53-55) en MNCN (15.05/47531). Paratipos en las siguientes colecciones: AMNH (1), BMNH (20080484) (1), MNHN (1), MHNS (4, Fig. 160, y 1 j), CJP (1, 2 j), CJH (1), CDO (1), CPR (1). Todos estos ejemplares procedentes de la localidad tipo. Otros paratipos: Banc Seminole: 1 ej, 30 m (CJP); Cap Vert: 1 ej, intermareal (CJP); Bahía de Dakar: 8 ej, 30-40 m (MHNS); 11 c (MNHN); 1 c (MNHN, coll. Letellier); dragado en la bahía: 5 ej, 30 m (10D2-26; 10/10/2002) (MHNS); 4 ej, (10D2-5) (MHNS); 4 j, 20-40 m (MHNS); Bahía de Gorée: 1 c (MNHN).

Otro material estudiado: Senegal, Dakar: 1 c, 1 m (MHNS) (destruida para estudio radular); 1 c (deterioriada) (MNHN, coll. Denis).

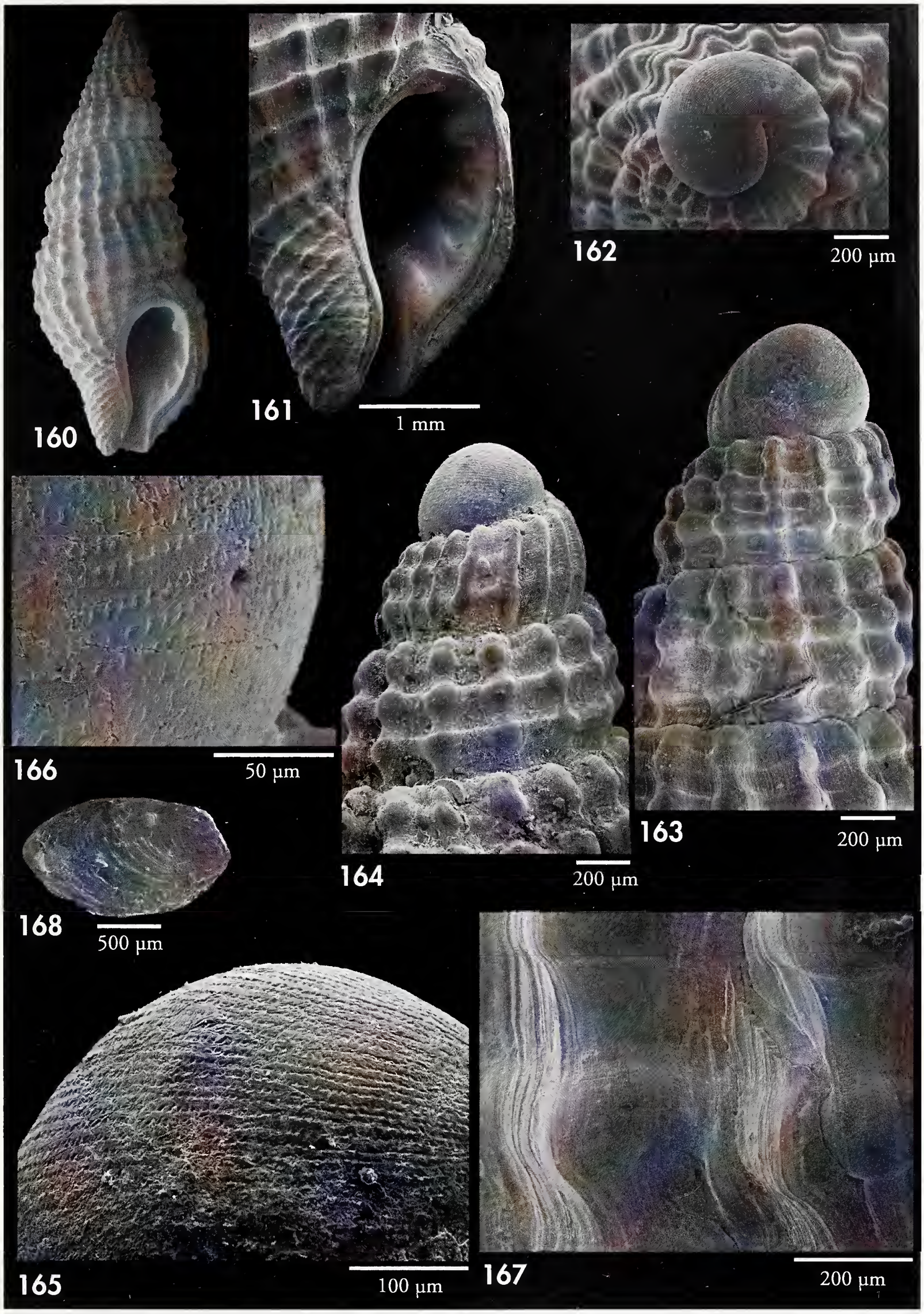
Localidad tipo: Gouye Teni M'Both, Bahía de Dakar, Senegal, 10-30 m.

Etimología: Las especie recibe el nombre de Lucia Cuesta, esposa del primer autor, por su constante colaboración y apoyo.

Descripción: Concha (Figs. 53-55, 160) fusiforme-alargada, sólida, con unas siete vueltas de espira y una altura máxima de 9.0 mm.

Protoconcha (Figs. 162-164) con 0,8 vueltas, y con una anchura de unas 675 µm (núcleo: 237 µm, primera media vuelta: 595 µm) y unas 650 µm de altura; en ella aparecen unos cincuenta cordones espirales muy finos, separados por interespacios de anchura similar (Fig. 165). En los interespacios se observan las típicas incisiones (Fig. 166) de las *Chauvetia*. Hacia el final, hay siete u ocho costillitas axiales rectas, algo opistoclinas. La parte superior de las costillas está curvada sobre una estrecha repisa subsutural.

Teleoconcha con una escultura de cordones espirales algo más anchos que sus interespacios y costillas de anchura similar a sus interespacios. En el inicio de la teleoconcha aparecen tres cordones espirales. En la cuarta vuelta aparece en la parte superior, bajo la sutura, un cuarto cordón. En la última vuelta, hay cuatro cordones por encima de la inserción labial y, hacia la base, aparecen de doce a catorce cordoncillos más. Los superiores están claramente separados por interespacios claros y a medida que se acercan al canal sifonal se van aproximando entre ellos, quedando los ocho o diez más inferiores prácticamente juntos. La escultura axial es menos relevante y está formada por costillas verti-



Figuras 160-168. *Chauvetia luciacuestae* spec. nov. 160: paratipo, 7,9 mm (MHNS); 161: detalle de la abertura; 162-164: protoconcha; 165, 166; detalle de la microescultura de la protoconcha; 167: detalle de la microescultura de la teleoconcha; 168: opérculo.

Figures 160-168. Chauvetia luciacuestae *spec. nov. 160: paratype, 7.9 mm (MHNS); 161: detail of the aperture; 162-164: protoconch; 165, 166: detail of the microsculpture of the protoconch; 167: detail of the microsculpture of the teleoconch; 168: operculum.*

cales o un poco inclinadas, de forma irregular, siendo unas dieciocho en la última vuelta. Se prolongan por debajo de la inserción labial acabando cerca del inicio del canal sifonal. Al cruzarse cordones y costillas se forman nódulos redondeados. No hay microescultura alguna (Fig. 167). La ultima espira ocupa el 53 % de la altura total de la concha.

Abertura (Figs. 76, 161) oval, que alcanza el 38% de la altura de la concha. En el interior del labio externo se aprecian cinco dientes, de los que el superior es más pronunciado y el inferior constituye el borde externo del canal sifonal.

Color de la concha blanco-leche de fondo, sobre el que aparecen los nódulos del cruce de cordones y costillas que son de color castaño rojizo.

Dimensiones: el holotipo mide 8,8 x 3,0 mm.

Animal totalmente blanco leche con opérculo amarillento. Opérculo (Figs. 168, 183) ovoide, núcleo subterminal; en el interior, inserción ovoide, casi circular.

Distribución: Sólo conocida de la Bahía de Dakar, viviendo en fondos arenosos de alrededor de 30 m.

Comentarios: El peculiar patrón de coloración permite distinguirla de otras *Chauvetia* de similar tamaño que hay en la zona como *C. candidissima* o *C. tenuisculpta*.

Fuera del área de estudio, se podría confundir con *C. lefebvrei* (Maravigna, 1840), que existe en las costas atlánticas de Marruecos así como en las costas africanas mediterráneas y en algunas localidades europeas del Mediterráneo occidental (Horro y Rolán, 2004). *C. lefebvrei* es bastante variable si la consideramos en toda su área de distribución, pero no lo es a escala local: los ejemplares estudiados de las costas argelinas son de menor tamaño y más ovales que los de las conchas atlánticas. Estas conchas pueden presentar el típico color a manchones o bien ser de color uniforme, en este caso muy parecidas a *C. retifera* (Reeve, 1845) y confundibles si no se comparan sus protoconchas. En cualquier caso la forma atlántica de *C. lefebvrei* es proporcionalmente más ancha y maciza, sus costillas son más anchas y están más juntas, y sus nódulos de cruzamiento más planos y rectangulares que los de la especie de Senegal.

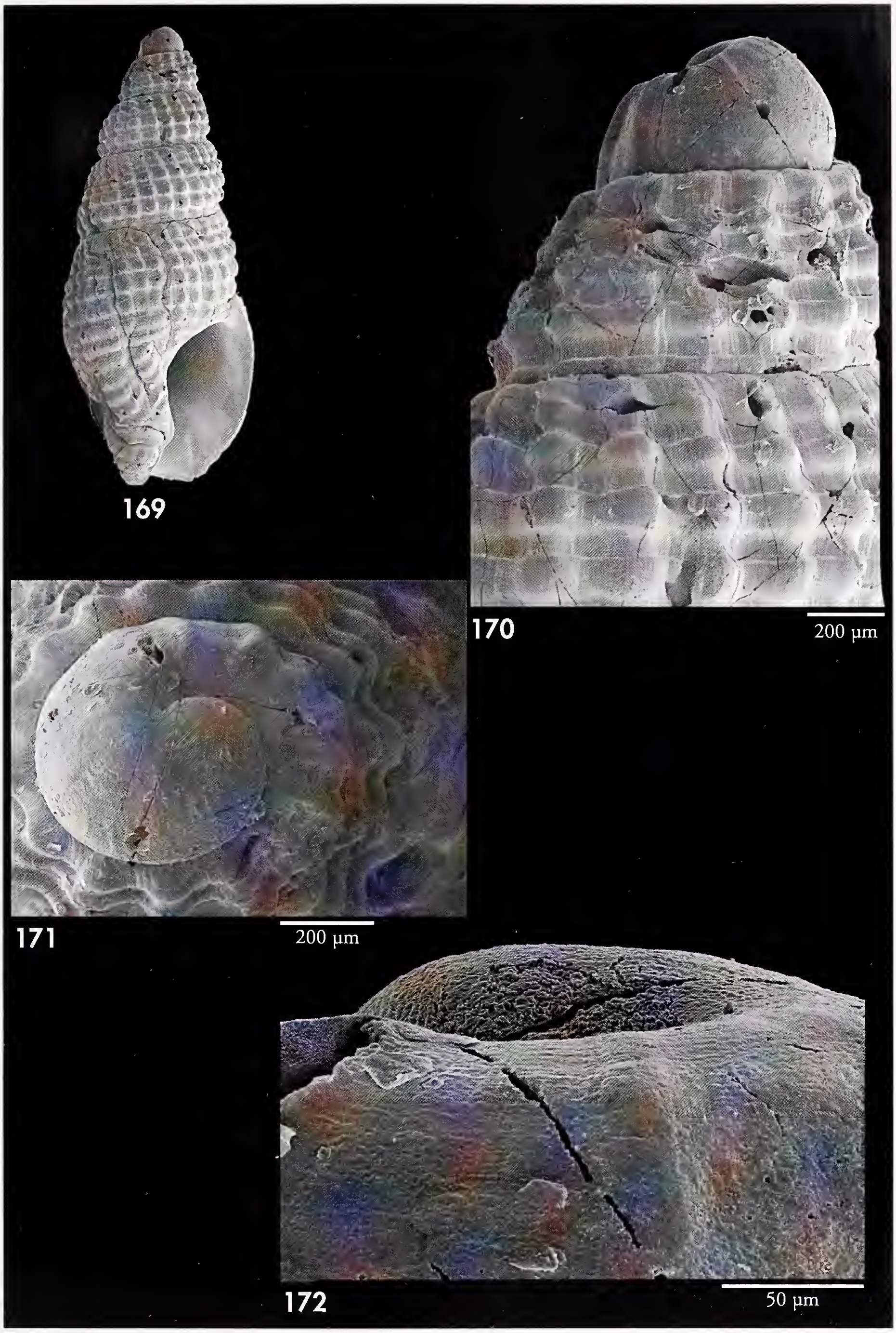
Chauvetia multilirata spec. nov. (Figs. 56, 57, 77, 169-172)

Material tipo: Holotipo (Figs. 56, 57, 169) en el MNCN (15.05/47532).
Localidad tipo: Cap Vert (09/1945) Dakar, Senegal.
Etimología: El nombre específico alude al elevado número de cordones espirales de la concha, un carácter diferencial muy peculiar en esta especie.

Descripción: Concha (Figs. 56, 57, 169) fusiforme, poco alargada, sólida, ancha, con unas cinco vueltas de espira y 5.8 mm de altura.

Protoconcha (Fig. 170, 171) con 0,8 de vuelta, poco elevada, con una anchura de 690 μm (núcleo: 300 μm; primera media vuelta: 515 μm) alcanzando una altura de 380 μm. En el ejemplar estudiado está ligeramente desgastada pero se puede observar la existencia de débiles estrías estrechas, muy numerosas (Fig. 172). Presenta seis o siete costillas curvadas que aumentan progresivamente de anchura. La transición con la teleoconcha no es muy clara y se considera como tal el momento en el que van apareciendo los cordones espirales de la teleoconcha.

Teleoconcha con un perfil de las vueltas plano o ligeramente convexo. Sutura no ondulada poco profunda. Está ornamentada con cordones espirales y costillas, ambos de anchura claramente mayor que sus interespacios, y que casi están ocultos al formarse en su cruce unos nódulos grandes y rectangulares. En las dos primeras vueltas hay cuatro cordones, de los que el superior forma el reborde subsutural. En la



Figuras 169-172. *Chauvetia multilirata* spec. nov. 169: holotipo, 5,8 mm (MNCN); 170, 171: protoconcha; 172; detalle de la microescultura de la protoconcha.
Figures 169-172. Chauvetia multilirata *spec. nov. 169: holotype, 5.8 mm (MNCN); 170, 171: protoconch; 172; detail of the microsculpture of the protoconch.*

penúltima vuelta, ya aparecen seis cordones, de los que los dos superiores son un poco más estrechos. En la última vuelta, hay seis cordones, apareciendo un séptimo muy fino sobre la sutura: los dos o tres superiores están muy juntos y son más pequeños, distinguiéndose con dificultad. En la base de la concha hay de diez a doce cordones más. Las costillas axiales son algo curvadas y prosoclinas. En la última vuelta, que representa el 60% de la altura total de la concha, hay una veintena de costillas.

Abertura (Figs. 77) oval, alcanza el 40% de la altura total. Canal sifonal corto y ancho.

Dimensiones: el holotipo mide 5,8 x 2,4 mm.

Color de la concha blanco sucio, con zonas ligeramente crema.

Distribución: Sólo conocida por el holotipo.

Comentarios: La protoconcha parece ser uno de los rasgos distintivos más característicos de esta especie, al ser corta, ancha y con escultura espiral muy fina. Los otros son: el número elevado de cordones espirales y los nódulos rectangulares grandes.

En el área estudiada, por su color, puede recordar a juveniles de *C. tenuisculpta* y con *C. candidissima*, de los que se diferencia porque su abertura es claramente de una concha adulta. Además, *C. candidissima* se diferencia por menor número de costillas axiales y cordones espirales con interespacios más anchos, protoconcha más elevada y menos ancha. *C. tenuisculpta*, además, tiene una escultura axial en su protoconcha muy marcada.

Fuera del área de estudio podría recordar a una pequeña *C. lefebvrei* albina, pero se distinguiría por el mayor número de los cordones espirales y porque su protoconcha es menos elevada.

Otras especies de color blanco, como *C. robustalba* spec. nov. o ejemplares blancos de *C. pardofasciata*, tienen menor número de cordones, los nódulos son más pequeños y la protoconcha más elevada y de color castaño.

Chauvetia pardacuta spec. nov. (Figs. 58, 59, 78, 173-180)

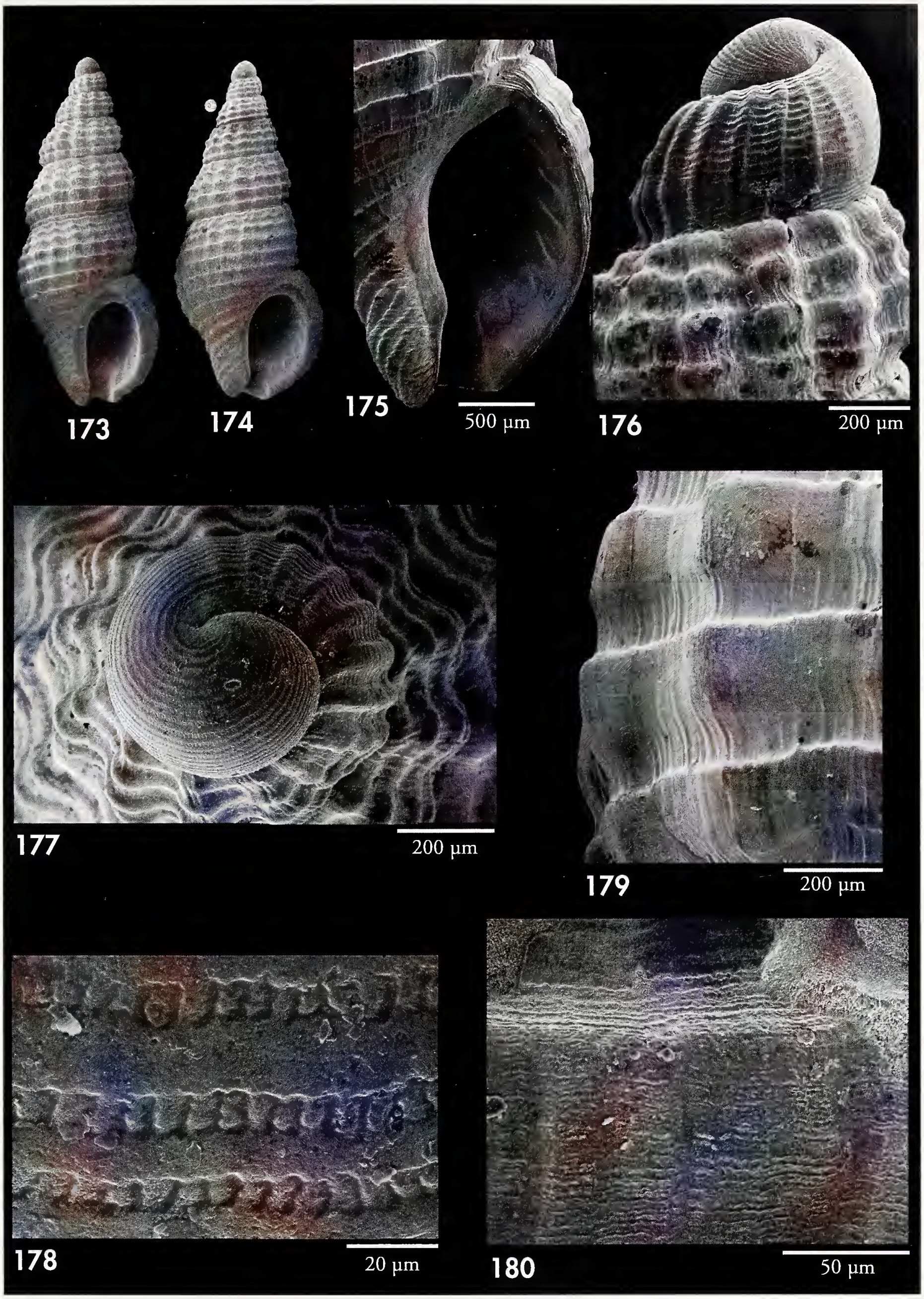
Chauvetia sp. 2. Micali, 1999. *Boll. Malac.*, 34: 66, fig. 10.

Material tipo: Holotipo (Fig. 173) en MNCN (25.05/47533), paratipos en las siguientes colecciones: AMNH (1), BMNH (20080485) (1), MNHN (1, Fig. 174), MHNS (4), USNM (1), CJH (1), CDO (1), CPR (1). Otros paratipos: Charbonier: 2 c, 34 m, (CJP).
Localidad tipo: N´Gor, 1-4 m, Dakar, Senegal (01/1984).
Etimología: El nombre específico alude a dos caracteres de la especie: su color y la forma puntiaguda de la concha.

Descripción: Concha (Figs. 58, 59, 173, 174) fusiforme, con la espira muy alargada, sólida, con unas siete vueltas de espira.

Protoconcha (Figs. 176, 177) con 0,8 de vuelta tiene 600 μm de anchura (núcleo: 320 μm; primera media vuelta: 480 μm) y 540 μm de altura. Presenta cordones longitudinales de anchura variable algo más anchos que sus interespacios, los cuales presentan las típicas incisiones axiales características del género (Fig. 178). Al final de la protoconcha se pueden observar una veintena de cordoncillos que cabalgan sobre las costillas axiales, que son unas ocho, bastante ortoclinas, que van ganando en anchura hacia el final y que se curvan por arriba sobre una estrecha repisa.

Teleoconcha con cordones espirales algo más anchos que sus interespacios (Fig. 179). En la primera vuelta hay tres cordones de una anchura similar, por encima de ellos, y un cuarto cordón se intuye en el reborde subsutural. En la segunda vuelta, este cordón ya es visible pero más estrecho que los tres inferiores. En la tercera vuelta hay cinco cordones, los dos superiores más estrechos (la mitad aproximadamente) que los tres inferio-



Figuras 173-180. *Chauvetia pardacuta* spec. nov. 173: holotipo, 6,4 mm (MNCN); 174: paratipo, 6,3 mm (MNHN); detalle de la abertura; 176, 177: protoconcha; 178; detalle de la microescultura de la protoconcha; 179: escultura de la teleoconcha; 180: detalle de la microescultura de la teleoconcha.

Figures 173-180. Chauvetia pardacuta *spec. nov. 173: holotype, 6.4 mm (MNCN); 174: paratype, 6.3 mm (MNHN); detail of the aperture; 176, 177: protoconch; 178; detail of the microsculpture of the protoconch; 179: sculpture of the teleoconch; 180: detail of the microsculpture of the teleoconch.*

res. Esta proporción se mantiene hasta la última vuelta, en la que se aprecian estos cinco cordones por encima de la inserción labial, pero que pueden llegar a ser seis o siete. En la parte basal, hay unos once cordoncillos que se van aproximando entre sí conforme se acercan al canal sifonal. Las costillas axiales son poco elevadas y tienen una anchura similar a sus interespacios. Al cruzarse con los cordones forman nódulos redondeados. Con grandes aumentos (Fig. 180) se puede apreciar la existencia de estriación espiral en toda la superficie. La última vuelta representa el 50% de la altura total.

Abertura (Figs. 78, 175) oval que supone el 34 % de la altura de la concha. En el interior del labio externo se observan siete pliegues dentarios. Canal sifonal corto y muy abierto, poco evidente.

Color de la concha castaño oscuro bastante uniforme.

Dimensiones: el holotipo mide 6,4 x 2,6 mm

Animal desconocido.

Distribución: Sólo conocida de la zona de N'Gor del área de Dakar, Senegal.

Comentarios: *Chauvetia joani* spec. nov. se diferencia porque tiene la sutura más pronunciada, los cordones espirales son más sobresalientes, excepto los subsuturales, que son muy atenuados, y las costillas axiales están presentes en menor número. Además, el núcleo de la protoconcha es más pequeño y el número de costillas axiales al final de la misma es algo menor.

C. tenebrosa spec. nov. es más pequeña, con menos vueltas de espira, con menos costillas axiales, protoconcha más pequeña, también con menos cordoncillos espirales y también menos costillas axiales en la proximidad de la teleoconcha.

COMENTARIOS FINALES

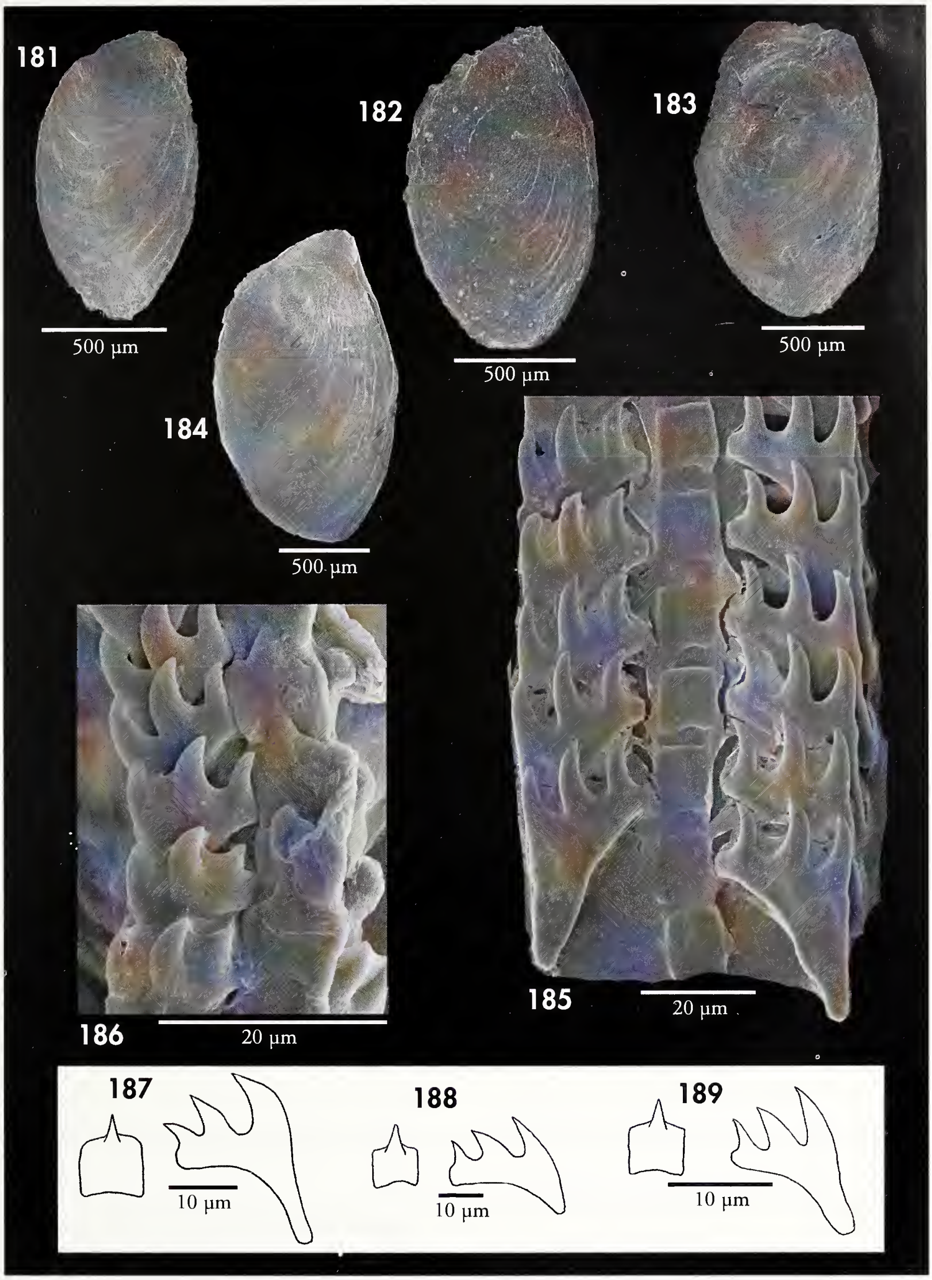
Se han estudiado unas 3000 conchas y ejemplares del género *Chauvetia* de la zona de Senegal, donde, en total, se han encontrado 14 especies.

De estas especies, 4 pudieron ser asignadas a nombres que ya eran previamente conocidos: *C. soni*, *C. affinis*, *C. tenuisculpta* y *C. lamyi*, especies que ya eran conocidas del área de Senegal de donde fueron descritas.

El resto de las especies (nada menos que 10) resultaron ser nuevas para la ciencia. Esto supone que, en total, se considera que existen en el área de Dakar al menos 14 especies, lo que resulta un número sorprendentemente elevado. Hay que recordar, que la zona se ha considerado una "casi-isla" debido al aislamiento que presentan sus hábitats rocosos rodeados por grandes extensiones de fondos arenosos tanto hacia el norte como hacia el sur. Por este motivo se ha comportado como un área adecuada para la especiación (como una isla) y por ese motivo se han originado multitud de endemismos, lo que ya ha sido mencionado para otros grupos de moluscos, como Conidae, Rissoidea, Turridae, etc.

El género *Chauvetia* es conocido de una extensión relativamente reducida: Mediterráneo, Canarias, costa oeste africana (Marruecos, Sahara y Mauritania) y Senegal. Alguna especie se ha extendido al Atlántico ibérico y alguna aislada se ha encontrado en las islas Británicas y norte de Francia. Curiosamente, en alguna de estas áreas (Mediterráneo, Dakar y Canarias) existe un alto índice de endemicidad.

Por debajo de la zona mencionada no se conocen especies de este género, con la excepción de un único ejemplar, probablemente perteneciente a *Chauvetia* (dato no publicado), recolectado en la isla de São Tomé, que ha sido estudiado por los autores, y que parece ser una verdadera especie de este género. Por supuesto, no tiene que ver con ejemplares del género *Pradoxa* Rolán y Fernandes, 1990, que pertenecen a Muricidae, y que, frecuentemente se han confundido con especies de *Chauvetia*, debido a las características morfológicas de su concha.



Figuras 181-184. Opérculos: 181: *Chauvetia affinis*, Dakar; 182: *Chauvetia joani*, Dakar; 183: *Chauvetia luciacuestae*, Dakar; 184: *Chauvetia tenuisculpta*, Dakar. Figuras 185-189. Rádulas de *Chauvetia*. 185: *Chauvetia tenuisculpta*; 186: *Chauvetia lamyi*; 187: *Chauvetia joani*; 188: *Chauvetia robustalba*; 189: *Chauvetia affinis*.

Figures 181-184. Opercula: 181: Chauvetia affinis*, Dakar; 182:* Chauvetia joani*, Dakar; 183:* Chauvetia luciacuestae*, Dakar; 184:* Chauvetia tenuisculpta*, Dakar. Figuras 185-189. Radulae of* Chauvetia*. 185:* Chauvetia tenuisculpta*; 186:* Chauvetia lamyi*; 187:* Chauvetia joani*; 188:* Chauvetia robustalba*; 189:* Chauvetia affinis.

En el presente trabajo se han estudiado de forma especial algunos caracteres del género, como los de la protoconcha, que es muy característica: siempre paucispiral y generalmente muy ancha. En esta protoconcha, en pocos casos existe una escultura axial extendida a toda ella (como en *C. tenuisculpta* y en *C. javieri*); casi siempre esta escultura está reducida a unas pocas costillas en la zona de transición con la teleoconcha, en número variable, aunque en algunas especies el número de costillas puede ser muy escaso, como ocurre en *C. candidissima*, *C. joani*, *C. pelorcei* y *C. pardofasciata*; también a veces hay otros caracteres diferenciales de la protoconcha, como ser muy globosa (en el caso de *C. robustalba*) o algo aplanada (como en *C. multilirata*).

La escultura espiral de la protoconcha está formada por cordoncillos de forma casi constante, aunque algunas especies apenas los tienen, como ocurre en *C. multilirata*, *C. candidissima*. En cuanto a la escultura entre los cordones, esta formada casi siempre por estrías o cordoncillos en sentido axial, aunque en algunas ocasiones, esta escultura es difícilmente apreciable, como ocurre en *C. tenebrosa* o *C. pelorcei*.

La rádula fue estudiada en algunas especies, y observamos que, dentro de un patrón general similar, hay diferencias entre unas a otras, aunque la dificultad está en poder apreciar la variabilidad intraespecífica, para lo que sería preciso haber realizando un cierto número de estudios radulares para cada una de las especies, lo que representa una notable dificultad dada la pequeñez de la rádula, y la relativa escasez de material recolectado vivo.

El opérculo mostró ser ovoide, con un núcleo subcentral o casi terminal. Pero también haría falta el estudio de una cierta cantidad de ejemplares para poder conocer la variabilidad.

Al mismo tiempo que el presente trabajo, se ha iniciado una revisión de las especies del Mediterráneo, así como el estudio de las especies de profundidad del área de Sahara-Mauritania y de las especies de Canarias.

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Fusinus buzzurroi (Gastropoda: Fasciolariidae), a new species from Croatian coasts

Fusinus buzzurroi (Gastropoda: Fasciolariidae), una nueva especie de las costas croatas

Jakov PRKIĆ* and Paolo RUSSO**

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ABSTRACT

A new species of *Fusinus* from Croatian coasts of Dalmatia is described and figured. Type material was collected off Mljet Island, Croatia, at depths of 60 to 100 m in association with *Corallium rubrum* (Linnaeus, 1758), but the species was also recorded from other localities along Dalmatian coasts at different habitats and bathymetrical ranges.

RESUMEN

Se describe y figura una nueva especie de *Fusinus* procedente de la costa dálmata de Croacia. El material tipo se recolectó frente a la isla de Mljet, Croacia, en profundidades de 60 a 100 m asociado con *Corallium rubrum* (Linnaeus, 1758), pero la especie se encontró también en otras localidades de la costa dálmata, en habitats y profundidades distintos.

KEY WORDS: Gastropoda, Fasciolariidae, *Fusinus buzzurroi*, new species, Mediterranean Sea, recent.
PALABRAS CLAVE: Gastropoda, Fasciolariidae, *Fusinus buzzurroi*, nueva especie, Mediterráneo, reciente.

INTRODUCTION

The family Fasciolariidae J. E. Gray, 1853 is represented in the Mediterranean by two genera, *Fasciolaria* Lamarck, 1799 and *Fusinus* Rafinesque, 1815, belonging to the subfamilies Fasciolariinae J. E. Gray, 1853, and Fusininae Wrigley, 1927, respectively. Some specimens ascribable to *Fusinus* are commonly found along the Dalmatian coasts; our samplings pointed out the presence of several individuals of a peculiar *Fusinus*, collected in association with *Corallium rubrum* (Linnaeus, 1758) at different depths, depending on the locality: 60 to 100 m off the islands of Mljet, Lastovo and Sušac, 35 to 60 m off Molat, Sestrunj, Škarda and Premuda, 80 to 90 m off Žirje. This fasciolarid also occurs in other habitats, being observed off Rivanj Island at a depth of 20 m living on rocky bottoms rich in gorgonians, associated with the bryozoan *Reteporella beaniana* (King, 1846) (Alen Petani, Zadar, pers. comm.). An accurate investigation of shell morphology of these specimens revealed that we are in the presence of a species new to science. The methods for the evaluation of protoconch whorls follow AARTSEN AND VERDUIN (1978).

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Abbreviations:

CGB Collection Giovanni Buzzurro, Biassono, Milan, Italy
CJP Collection Jakov Prkić, Split, Croatia
CPR Collection Paolo Russo, Venice, Italy
MNHM Museo di Storia Naturale di Milano, Milan, Italy
d= diameter
h = height

SYSTEMATICS

Family FASCIOLARIIDAE J. E. Gray, 1853
Subfamily FUSININAE Wrigley, 1927
Genus *Fusinus* Rafinesque, 1815

Fusinus buzzurroi n. sp. (Figs. 1-3)

Type material: The holotype MNHM Mo 33638 is housed at Collezione Malacologica del Museo Civico di Storia Naturale di Milano (MNHM), Italy. The paratypes are the following: paratype A, 21.8 x 10.4 mm (CPR); paratype B, 21.4 x 10.7 mm (CPR); paratype C, 19.8 x 8.6 mm (CPR); paratype D, 18.4 x 8.9 mm (CPR); paratype E, 17.4 x 8.3 mm (CPR); paratype F, 22.4 x 10.2 mm (CJP); paratype G, 21.0 x 9.8 mm (CJP); paratype H, 19.4 x 8.7 mm (CJP); paratype I, 20.5 x 9.6 mm (CJP); paratype J, 17.5 x 7.8 mm (CJP); paratype K, 16.2 x 7.5 mm (CJP); paratype L, 17.4 x 8.2 mm (CGB); paratype M, 17.7 x 7.9 mm (CGB); paratype N, 19.0 x 8.4 mm (CGB); paratype O, 16.8 x 7.9 mm (CGB); all from the type locality.
Other material examined: About twenty specimens from the islands of Lastovo, Molat and Žirje (Dalmatia, Croatia).
Locus typicus: Mljet Island, Dalmatia (Croatia), in association with *Corallium rubrum*, at depths of 60 to 100 m.
Derivatio nominis: This species is named after our unforgettable and unforgotten friend Giovanni Buzzurro.

Description: Shell solid and fusiform, consisting of 1.3-1.4 protoconch whorls and 6-7 teleoconch whorls, rather small for genus, measuring up to 26.4 x 11.7 mm, usually from 16 to 22 mm in height.

Protoconch brownish, mamillate, striated by 6 obvious, equidistant spiral threads, with interspaces completely smooth, about 755 μm in diameter, with an apical nucleus measuring 252 μm across (Fig. 2).

Teleoconch whorls convex, slightly carinated by an obvious, but not very raised, keel, separated by well-marked, but not canaliculated sutures. The sculpture consists of strong, raised and well-spaced axial ribs, 6-7 on each whorl, rarely 8, and closely spaced primary spiral cords, which are stronger where they pass over the axial ribs. The spiral sculpture also consists of secondary threads, which are more evident on the last two or three whorls.

The body whorl represents 60-64 % of the total shell height. Aperture oval, outer lip varicose, internally lirate with 7-10 elongate teeth, columellar callus thin, but obvious. A parietal tooth is well evident in the upper part of aperture. Some studied specimens show two or three columellar folds, more or less evident, which are caused by the underlying primary spiral cords, at the base of the columella. Siphonal canal short, broad and curved, slightly deviating to the left when seen in apertural view. Operculum corneous, brown in colour, with an apical nucleus.

The shell colour varies, usually is brownish, rarely whitish or pale beige, with spiral cords only slightly darker than the background colour, sometimes with a whitish keel. In some studied specimens the spiral cords are dark brown or reddish-brown, conspicuously darker than the background colour.

Figure 1. *Fusinus buzzurroi* n. sp., Mljet Island (Croatia), 60-100 m. A-C: holotype (MNHM Mo 33638), apertural, lateral and dorsal views, 26.4 x 11.7 mm; D: paratype A, apertural view, 21.8 x 10.4 mm; E: paratype I, apertural view, 20.5 x 9.6 mm; F: paratype D, dorsal view, 18.4 x 8.9 mm; G: paratype F, apertural view, 22.4 x 10.2 mm; H, I: paratype B, apertural and dorsal views, 21.4 x 10.7 mm.

Figura 1. Fusinus buzzurroi *n. sp., Mljet Island (Croacia), 60-100 m. A-C:, holotipo (MNHM Mo 33638), vista apertural, lateral y dorsal, 26,4 x 11,7 mm; D: paratipo A, vista apertural, 21,8 x 10,4 mm; E: paratipo I, vista apertural, 20,5 x 9,6 mm; F: paratipo D, vista dorsal, 18,4 x 8,9 mm; G: paratipo F, vista apertural, 22,4 x 10,2 mm; H-I: paratipo B, vista apertural y dorsal, 21,4 x 10,7 mm.*

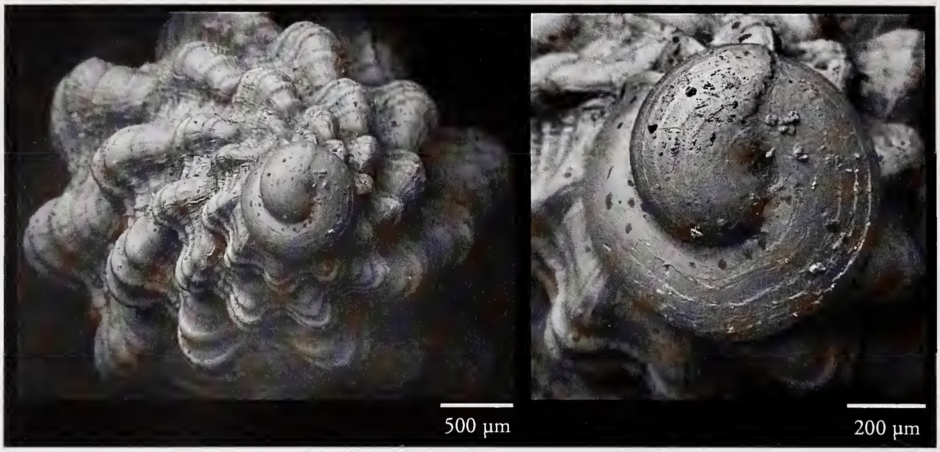

Figure 2. *Fusinus buzzurroi* n. sp., Mljet Island (Croatia), 60-100 m, protoconch.
Figura 2. Fusinus buzzurroi *n. sp., Mljet Island (Croacia), 60-100 m, protoconcha.*

Holotype (Figs. 1A-1C) coloured pale beige, slightly darker between the axial ribs, consisting of 8.3 whorls, 1.3-1.4 of which belonging to the protoconch. There are 6 axial ribs on the body whorl, and 6-7 on the preceding whorls. There are 3 primary spiral cords on the first teleoconch whorl, 4 on the second and third whorls, 6 on the fourth to sixth whorls and 16 to 17 on the body whorl, the later ones reaching the base of siphonal canal. Secondary spiral cords are evident especially on the last two whorls, as well as along the siphonal canal. The body whorl represents 59.8% of the total shell height.

Geographic distribution: This species is presently known from the Croatian coasts, its northern limit being represented by Premuda Island, and southern limit by Mljet Island.

Habitat: All the examined material was collected in association with *Corallium rubrum*, at depths of 35 to 100 m. *F. buzzurroi* is consistently found in the material collected by Dalmatian coral fishermen; it is more rarely recorded from rocky bottoms lacking red coral. At least one specimen was observed living in association with *Reteporella beaniana* (off Rivanj Island at a depth of 20 m), a bryozoan frequently associated with coralligenous assemblages. Our data suggest that this species does not live on either detritic or shallow rocky bottoms (0 to 15 m).

DISCUSSION

According to the recent revisions of Mediterranean species of the genus (BUZZURRO AND RUSSO, 2007, 2008), 15 species of *Fusinus* are known for the Mediterranean Sea:

F. alternatus Buzzurro and Russo, 2007 ex Settepassi

F. cretellai Buzzurro and Russo, 2008 (a replacement name for *Fusus crassus* Pallary, 1901)

F. dimassai Buzzurro and Russo, 2007

F. dimitrii Buzzurro and Ovalis, 2007

F. eviae Buzzurro and Russo, 2007

F. labronicus (Monterosato, 1884)

F. margaritae Buzzurro and Russo, 2007

F. parvulus (Monterosato, 1884)

F. profetai Nofroni, 1982

F. pulchellus (Philippi, 1844)

F. rolani Buzzurro and Ovalis, 2004

F. rostratus (Olivi, 1792)

F. rusticulus (Monterosato, 1880)

F. syracusanus (Linnaeus, 1758)

F. verrucosus (Gmelin, 1791)

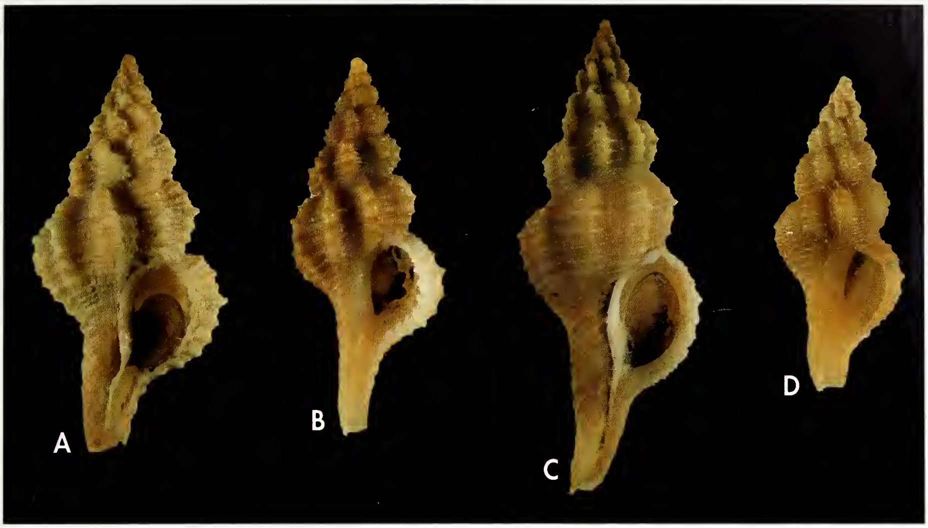

Figure 3. A. *Fusinus buzzurroi* n. sp. 21.4 x 10.2 mm. B. *Fusinus dimitrii* Buzzurro and Ovalis, 2007 17.8 x 7.4 mm. C. *Fusinus rostratus* (Olivi, 1792) 43.8 x 16.6 mm. D. *Fusinus parvulus* (Monterosato, 1884) 13,4 x 7,4 mm.

Figura 3. A. Fusinus buzzurroi *n. sp. 21,4 x 10,2 mm. B.* Fusinus dimitrii *Buzzurro and Ovalis, 2007 17,8 x 7,4 mm. C.* Fusinus rostratus *(Olivi, 1792) 43,8 x 16,6 mm. D.* Fusinus parvulus *(Monterosato, 1884) 13,4 x 7,4 mm.*

F. rostratus, F. syracusanus and *F. buzzurroi* surely occur along the Dalmatian coasts. Recent investigations call into question the occurrence of two other species recorded from Dalmatia (*F. pulchellus* and *F. parvulus*), and no specimen has been recorded during the many years of research in this area by one of the authors (J. Prkić). The record of *F. pulchellus* in association with "corallo nobile" (*C. rubrum)* reported by BRUSINA (1866) is probably to be reinterpreted as a misidentification of the new species here described. The same goes for the record of *F. parvulus*, in that it may be confused with *F. buzzurroi* at some growth stages.

Fusinus buzzurroi can be compared to *F. rostratus* (Olivi, 1792), *F. dimitrii* Buzzurro and Ovalis, 2007, and *F. parvulus* (Monterosato, 1884) (see Figure 3). Conchometrical parameters (Table I) are reported for each species (following BUZZURRO AND RUSSO, 2007).

F. buzzurroi differs from *F. rostratus* (Fig. 3C) for the much smaller size, the stubbier shape, the smaller protoconch (755 μm against 910 μm of North-Adriatic populations of *F. rostratus)*. In *F. rostratus* the axial ribs start just after the suture in the adapical part (BUZZURRO AND RUSSO, 2007), while in *F. buzzurroi* they begin intersecting the ribs of the next whorl in the sutural area. *F. rostratus* shows a much longer siphonal canal. In *F. rostratus* there are some populations having a slight keel, others a well-developed keel, while others are quite acarinate (BOMBACE, 1971); *F. buzzurroi* has always a slight keel. In *F. buzzurroi* the average of conchometrical parameters h/d has a value of 2.14 against 2.65 in *F. rostratus* (Table I). In *F. rostratus* the habitat is more diversified, ranging from circalittoral (VIO AND DE MIN, 1994) to bathyal mud and white coral biocoenoses (DIEUZEIDE, 1950; CARPINE, 1965; BOMBACE, 1969), extending to a depth of 823 meters (D'AMICO, 1912). Records in association with red coral were never reported from Dalmatian coasts.

F. buzzurroi differs from *F. dimitrii* (Fig. 3B) in the larger size, the less elon-

Table I. Conchometrical parameters in *Fusinus buzzurroi*, *F. rostratus*, *F. dimitrii* and *F. parvulus* (h and d in mm).
Tabla I. Parámetros de la concha en Fusinus buzzurroi, F. rostratus, F. dimitrii *y* F. parvulus *(h y d en mm).*

Fusinus buzzurroi				*Fusinus dimitrii*			
No.	h	d	h/d	No.	h	d	h/d
1	26.40	11.70	2.26	1	13.30	5.50	2.42
2	21.40	10.70	2.00	2	21.00	8.00	2.63
3	21.80	10.40	2.10	3	16.20	6.00	2.70
4	21.00	9.80	2.14	4	17.00	8.00	2.13
5	22.40	10.20	2.21	5	23.10	9.00	2.57
6	20.50	9.60	2.13	6	17.50	7.00	2.50
7	18.40	8.90	2.08	7	15.50	7.00	2.21
8	19.40	8.70	2.23	8	17.00	6.20	2.74
		average	2.14			average	2.49

Fusinus rostratus				*Fusinus parvulus*			
No.	h	d	h/d	No.	h	d	h/d
1	35.90	13.50	2.66	1	12.70	5.70	2.23
2	36.60	13.80	2.65	2	12.20	5.70	2.14
3	38.20	13.80	2.77	3	12.00	5.30	2.26
4	38.80	14.40	2.69	4	12.00	5.20	2.31
5	39.00	14.60	2.67	5	11.80	5.10	2.31
6	39.30	15.50	2.54	6	11.20	5.50	2.04
7	39.40	14.50	2.72	7	10.00	5.00	2.00
8	39.40	15.30	2.58	8	9.80	4.80	2.04
		average	2.65			average	2.17

gated profile, the lower number of axial ribs (numbering 8-9 in *F. dimitrii* against 6-7 in *F. buzzurroi* on the body whorl), the keel (always absent in *F. dimitrii*), the axial ribs broader and more prominent with wider interspaces, the presence of an obvious secondary spiral sculpture. *F. buzzurroi* has a shorter and more widely open siphonal canal; the protoconch is marked by 6 spiral threads, while it appears to be smooth in *F. dimitrii*; the operculum is brown in colour, being yellowish in *F. dimitrii*. With respect to conchometrical parameters, in *F. dimitrii* the average of h/d has a value of 2.49 against 2.14 in *F. buzzurroi*. Habitat is similar.

F. buzzurroi differs from *F. parvulus* (Fig. 3D) in the stouter and heavier shell, the number of axial ribs, (6-7 in *F. buzzurroi* and 8-9 in *F. parvulus*), the presence of secondary spiral cords and a keel, always absent in *F. parvulus*, the suture which is more marked in *F. parvulus*, the spire whorls more flattened in *F. parvulus*, the colour always uniform in *F. parvulus*, while in *F. buzzurroi* only the juveniles can be uniformly coloured, sometimes having spiral cords darker than background colour, the protoconch more raised in *F. parvulus*, more rounded in *F. buzzurroi*. Habitats and distributional ranges are different. Conchometrical parameters are similar.

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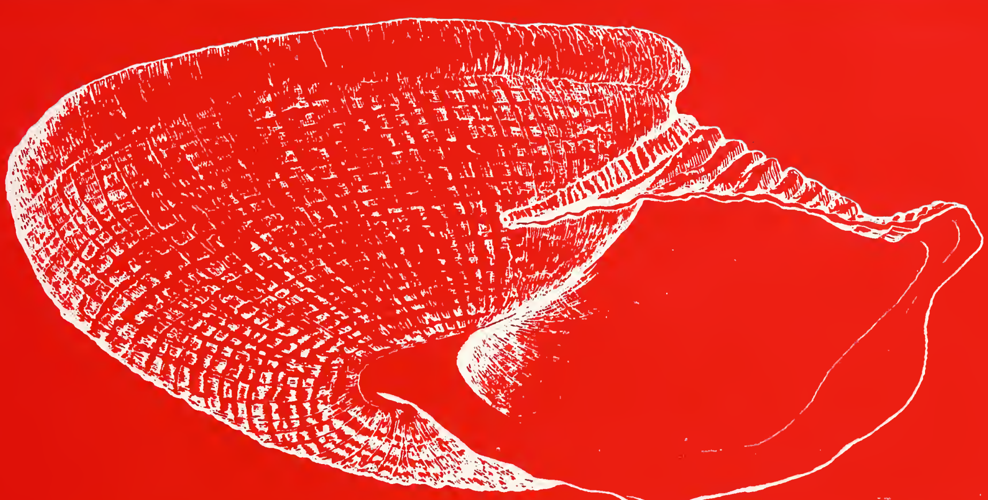

Oviedo, junio 2009

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Moluscos dulceacuícolas de la Reserva de la Biosfera "Dehesas de Sierra Morena", SO de la Península Ibérica

Freshwater molluscs from the Biosphere Reserve "Dehesas de Sierra Morena", SW Iberian Peninsula

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RESUMEN

Se ha estudiado la fauna de moluscos de agua dulce en 109 cursos de agua de la Reserva de la Biosfera "Dehesas de Sierra Morena", en el suroeste de la Península Ibérica. Han sido encontradas 19 especies (15 gasterópodos y 4 bivalvos) que se distribuyen siguiendo un gradiente de riqueza específica de oeste a este. Tal patrón biogeográfico es debido a variaciones climatológicas y a la distinta disponibilidad de agua a lo largo del eje mayor de la Reserva, que fluctúa entre las influencias atlánticas de la Sierra de Aracena y Picos de Aroche y las continentales más estresadas de la Sierra Norte y, sobre todo, la Sierra de Hornachuelos.

ABSTRACT

Faunistic of freshwater molluscs have been studied in a Mediterranean Biosphere Reserve "Dehesas de Sierra Morena". In 109 sampling points I have encountered 19 species (15 gastropods and 4 bivalves). Distribution of species richness describes a west-east gradient along the main Reserve axis. Such biogeographical pattern is related with climatic conditions and water availability of the Reserve, with Atlantic influences in Sierra de Aracena and Picos de Aroche and Mediterranean-continental in Sierra Norte and Sierra de Hornachuelos.

INTRODUCCIÓN

Los hábitats dulceacuícolas continentales se encuentran entre los más severamente impactados por la actividad humana (pérdida o degradación, especies introducidas, cambio climático), siendo el declive generalizado de su biodiversidad, a nivel global, mucho más acusado en éstos que en otros ecosistemas continentales o marinos (RICCIARDI Y RASMUSSEN, 1999; REVENGA Y KURA, 2003; MOUTHON Y DAUFRESNE, 2006). La distribución, abundancia y complejidad de las comunidades de macroinvertebrados de agua dulce está íntimamente ligada a factores que determinan la composición de las biocenosis tales como la estructura del hábitat y las interacciones bióticas que en él tienen lugar entre los organismos que componen dichas comunidades (VANNOTE, MINSHALL, CUMMINS, SEDELL Y CUSHING, 1980). Como caso particular, los hábitats dulceacuícolas mediterráneos están fuertemente influenciados por ciclos periódicos de

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gran variabilidad que fluctúan en torno a dos episodios que imponen duras presiones evolutivas en la fauna: fuertes avenidas invernales y extremas sequías estivales (Pires, Cowx y Coelho, 2000; Lake, 2003; Bonada, Rieradevall y Prat, 2006).

Uno de los objetivos de la Directiva Marco del Agua (DMA) (directiva 2000/60/CE del parlamento europeo y del consejo, de 23 de octubre de 2000) es la conservación, protección y mejora de la calidad ambiental de las aguas en la Unión Europea, debiendo para ello evaluar el estatus ecológico de los ríos europeos utilizando como instrumentos, entre otros, organismos bioindicadores (fitoplancton, macrófitas, invertebrados bentónicos y peces) como garantes de la calidad o degradación de dichas aguas (Pollard y Huxhan, 1998; Logan y Furse, 2002; Irvine, 2004). En ese sentido, y dado el carácter conservacionista y científico que inspira la creación de cualquier espacio protegido, es de desear que en ellos se potencie, desde el punto de vista del análisis biológico de las aguas continentales europeas, el estudio en profundidad de las comunidades de organismos que residen en dichos entornos, dotándolos de ese modo de herramientas adecuadas para abordar el análisis que propone la DMA.

Por otra parte, y desgraciadamente, el nivel actual de conocimiento acerca de nuestra fauna acuática dulceacuícola es claramente asimétrico y refleja el desigual "peso sistemático" de los distintos grupos de vertebrados e invertebrados que la componen. Dentro de estos últimos, la información que se dispone acerca de la biodiversidad de los macroinvertebrados "artrópodos" acuáticos es muy extensa (ver revisiones en Nieser y Montes, 1984; Rico, Pérez y Montes, 1990; Sánchez, Alba y Tierno, 2002, entre otros), mientras que los análisis faunísticos y ecológicos de los "no artrópodos" son, en el mejor de los casos, escasos (ver revisiones en Vidal-Abarca y Suárez (1985) y en Velasco (1990)). La Red Mundial de Reservas de la Biosfera (programa MaB, UNESCO; http://www.unesco.org.uy/mab/marco.html) ha sido diseñada, a nivel global, primariamente para la protección y conservación de ecosistemas terrestres y marinos representativos de los diferentes hábitats del planeta, siendo escasas las seleccionadas con el fin exclusivo de conservar hábitats dulceacuícolas (IUCN, 1994; Ramsar Convention on Wetlands, 2004). Como elementos diferenciales y representativos de entornos globales, y en aplicación de la DMA, sería de desear que la información disponible de la fauna de las Reservas de la Biosfera ibéricas excediera la tópica y extensa lista de vertebrados e invertebrados terrestres y estuviera complementada por listados de faunística de agua dulce para, de ese modo, facilitar el estudio y la evaluación del estatus ecológico de sus ecosistemas fluviales. Mientras que se dispone de suficiente información acerca de los vertebrados dulceacuícolas (Doadrio, 2002; Pleguezuelos, Márquez y Lizana, 2002), desgraciadamente no se dispone de listas actualizadas de invertebrados terrestres, y prácticamente ninguna de acuáticos, de la Reserva de la Biosfera "Dehesas de Sierra Morena" o entorno (Pérez-Quintero, Bech y Huertas, 2004).

Hasta el presente prácticamente no existen apenas datos acerca de la composición de la malacofauna dulceacuícola de esta Reserva de la Biosfera ibérica. Los únicos disponibles son descripciones muy parciales (Ortiz de Zárate y Ortiz de Zárate, 1961; Gasull, 1985), del entorno de la provincia de Huelva (Pérez-Quintero *et al.*, 2004; Pérez-Quintero, 2007), de provincias limítrofes con la Reserva (Bech y Altimira, 2003), de ámbito ibérico (Vidal-Abarca y Suárez, 1985) o de localidades puntuales donde se han descrito especies nuevas de Hydrobiidae (Arconada y Ramos, 2006; Arconada y Ramos, 2007b; Arconada, Delicado y Ramos, 2007). No existe información actual sobre la fauna de moluscos dulceacuícolas del Parque Natural de Sierra Norte de Sevilla y del Parque Natural de la Sierra de Hornachuelos en Córdoba (las otras dos áreas protegidas que forman, junto con el Parque Natural Sierra de Aracena y Picos de Aroche en Huelva, la Reserva de la Biosfera "Dehesas de Sierra Morena"). Con este artículo se pretende

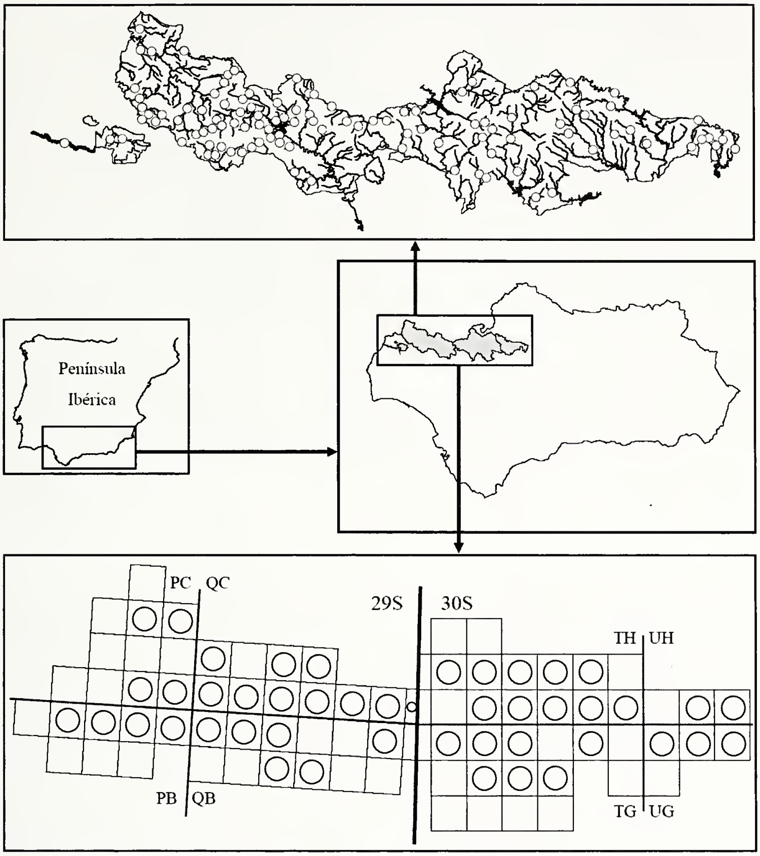


Figura 1. Situación geográfica de la Reserva de la Biosfera "Dehesas de Sierra Morena" en la Península Ibérica y localización de los 109 puntos muestreados.
Figure 1. Geographic situation of the Biosphere Reserve "Dehesas de Sierra Morena" in the Iberian Peninsula and location of the 109 sampling points.

contribuir al conocimiento de la malacocenosis dulceacuícola de la Reserva, aportando un análisis preliminar de su distribución geográfica en los cursos de agua muestreados y en sus respectivas cuadrículas UTM.

MATERIAL Y MÉTODOS

Área de estudio

El trabajo de campo se ha realizado en la Reserva de la Biosfera "Dehesas de Sierra Morena", localizada en el extremo suroccidental de la Península Ibérica (noroeste de Andalucía, España) (Fig. 1). Esta Reserva está formada por la unión de tres Parques Naturales: Sierra de Aracena y Picos de Aroche (SA, Huelva), Sierra Norte (SN, Sevilla) y Sierra de Hornachuelos (SH, Córdoba). El clima de la zona es mediterráneo pluviestacional oceánico (WORLDWIDE BIOCLIMATIC CLASSIFICATION SYSTEM), caracterizado por severas sequías estivales (junio-septiembre) y moderadas precipitaciones durante el invierno. La temperatura ambiente media oscila entre 15.0 y 18.9 ° C y la pluviosidad entre 232 y 1644 mm (VILLA Y HERNÁNDEZ, 2003).

Esta estacionalidad se refleja en la red hidrológica de la Reserva, en la que la

(Página derecha) Tabla I. Variables ambientales utilizadas para caracterizar los puntos de muestreo. Izquierda: media ± Desviación Standard y rangos (entre paréntesis) de los parámetros medidos en el total de la Reserva de la Biosfera (B) y en los tres Parques naturales (SA, SN y SH). Derecha: ANOVA entre zonas. Para las variables del hábitat: (*) GIS, (**): *in situ*, (***): Worldwide Bioclimatic Classification System. Para intervalos de hábitat: Pd= 1: <7%, 2: 7-15%, 3:> 15%; Vc= 1: lenta, 2: moderada, 3: moderada-rápida, 4: rápida; Pm= 1: riveras siempre secas durante el verano, 2: riveras siempre secas durante el verano pero con pozas aisladas, 3: riveras secas sólo durante sequías extremas, 4: riveras con flujo permanente. Para ANOVA, n.s.= no significativo; entre paréntesis diferencias no significativas entre zonas según el test HSD de Tukey.
(Right page) Table I. Environmental variables used to characterize the sampled sites. Left: mean ± Standard deviation and ranges (in parentheses) of the measured habitat parameters in the Biosphere Reserve as a whole (B) and in the three Natural Parks (SA, SN and SH). Right: ANOVA between zones. For habitat variables: (*): GIS, (**): in situ, (***): Worldwide Bioclimatic Classification System. For habitat intervals: Pd= 1: <7%, 2: 7-15%, 3: >15%; Vc= 1: slow, 2: moderate, 3: moderate-fast, 4: fast; Pm= 1: streams always dried during the drought period, 2: streams always dried during the drought period but with isolated pools, 3: streams dried only during severe droughts, 4: streams always with permanent flow. For ANOVA, n.s.= not significant; in parentheses non-significant differences between zones according to Tukey HSD test.

mayoría de los cursos de agua soporta acusados estiajes que implican disminución de caudal o desaparición de los mismos durante el verano (básicamente en la zona oriental de la Reserva). Las principales cuencas y subcuencas existentes son las de los ríos y riveras (de oeste a este): Chanza, Múrtigas, Huelva, Viar, Huéznar, Retortillo, Bembézar y Guadiato (López, 1998; Pozuelo, Gañán y Martín, 2005). El flujo natural de los cursos de agua de la Reserva está alterado por la presencia de siete embalses (de oeste a este): Aracena, Zufre, El Pintado, Huéznar, José Torán, Retortillo, Bembézar y Breña, con una capacidad total de envasado de 1273 hm3 y un rango que oscila entre 61 (Retortillo) y 342 (Bembézar) hm3 (http://www.embalses.net)

Trabajo de campo

Ciento nueve cursos de agua han sido muestreados durante Marzo-Junio de 2004 y Marzo-Junio de 2005 (Fig. 1), la mayoría (47.7%) de primer orden, 33,0% de segundo, 11,0% de tercero, 7.3% de cuarto y 0,9% de quinto orden (Gordon, McMahon, Finlayson, Gippel y Nathan, 2004). Los puntos de muestreo han sido seleccionados por su accesibilidad, analizando en cada uno de ellos dos parcelas de aproximadamente 30 m^2 (dependiendo de la anchura del curso de agua). Previamente al muestreo fueron medidos o estimados distintas características del hábitat, incluyendo parámetros climáticos, de heterogeneidad, geográficos, fisicoquímicos y estructurales de los cursos de agua (Tabla I). El muestreo de las malacocenosis se realizó en aguas de menos de 150 cm de profundidad, utilizando redes de 0,3 mm de luz de malla en todos los posibles microhábitats del cauce. Tras su captura, los individuos fueron lavados y conservados en etanol al 70%, excepto las náyades que eran identificadas y vueltas al curso de agua. Las especies fueron identificadas en el laboratorio tomando como referencia las siguientes publicaciones: Glöer (2002), Glöer y Meier-brook (2003), Killeen, Alridge y Oliver (2004) y Arconada y Ramos (2007b).

Análisis de los datos

Se han seguido tres aproximaciones para comparar la biodiversidad de la malacocenosis de los tres entornos protegidos: riqueza (de especies, Re, de gasterópodos, Rg, de bivalvos, Rb, y de familias, Rf), abundancia de especies (Ae) y diversidad de Shannon-Wiener (H´e).

La distribución de las especies ha sido analizada mediante dos tipos de representaciones: distribución en los pun-

	B	SA	SN	SH	$F_{2,106}$
Climáticos (Cl)					
Índice de aridez anual(***) (Ia)	1,0±0,3 (0,7-1,8)	0,8±0,2 (0,7-1,2)	1,2±0,2 (0,9-1,8)	1,4±0,02 (1,3-1,4)	78,7, p<0,001 (N-H)
Precipitación(***) (Pr) (mm)	864,5±181,1 (536-1126)	971,3±145,8 (766-1126)	692,9±85,4 (536-813)	716,5±56,6 (612-745)	69,3, p<0,001 (N-H)
Superavit hídrico(***) (mm) (Sh)	404,5±162,6 (141-627)	499,7±132,8 (319-627)	256,3±78,6 (141-378)	262,6±36,6 (195-281)	73,7, p<0,001 (N-H)
Déficit hídrico(***) (mm) (Dh)	387,7±81,1 (312-568)	347,8±46,7 (312-444)	404,9±58,8 (328-560)	532,4±70,7 (402-568)	62,9, p<0,001
Temperatura media del aire (***) (°C) (Ta)	18,7±1,1 (16,2-19,3)	15,6±0,8 (14,8-17,1)	16,1±1,2 (13,8-18,2)	18,4±1,7 (15,2-19,3)	34,8, p<0,001 (A-N)
Evapotranspiración(***) (mm) (Ev)	846,9±74,2 (755-1032)	819,8±34,4 (793-891)	841,4±56,2 (755-955)	986,3±90,7 (819-1032)	56, p<0,001 (A-N)
Heterogeneidad (He)					
Cobertura de macrófitas (**) (Cm)	25,4±12,3 (5-50)	29,5±11,8 (5-50)	19,5±9,7 (5-40)	18,2±11,9 (5-50)	10,9, p<0,001 (N-H)
FHI (**) (FHI)	51,5±7,8 (34-63)	54,8±6,4 (34-63)	46,3±6,7 (36-60)	46,9±8,2 (35-63)	19,7, p<0,001 (N-H)
Permanencia (**) (Pm)	2,3±1,2 (1-4)	3,2±1 (1-4)	1,8±0,9 (1-4)	2±1,2 (1-4)	24,6, p<0,001 (N-H)
Diversidad de sustratos (**) (H´s, escala de Wenworth)	1,4±0,2 (0,7-1,6)	1,5±0,1 (1-1,6)	1,3±0,2 (0,7-1,6)	1,4±0,1 (1,2-1,6)	5,7, p=0,001 (A-H, N-H)
QBR (**) (QBR)	58,2±13,4 (35-75)	59,5±13,2 (35-75)	55,9±13,9 (35-75)	56,4±13,4 (40-75)	n,s,
Geográficos (Ge)					
Altura (*) (m) (Al)	429,9±137 (114-740)	469,6±130 (220-740)	411,5±103,5 (119-635)	281,1±126 (114-578)	17,3, p<0,001 (A-N)
Pendiente (*)(1-3) (Pd)	1,7±0,6 (1-3)	1,8±0,6 (1-3)	1,4±0,6 (1-3)	1,6±0,8 (1-3)	5,3, p=0,006 (A-H, N-H)
Orden(*)(1-5) (Or)	1,8±1 (1-5)	1,6±0,9 (1-5)	2,1±1 (1-4)	2,4±1 (1-4)	7,9, p<0,001 (N-H)
Fisicoquímicos (Fq)					
Conductividad (**) (µS/cm) (Co)	394,6±159,6 (118,3-957)	359,5±162 (118,3-957)	449,7±151,4 (220-875)	445,8±122,6 (280-700)	5,9, p=0,004 (A-H, N-H)
Turbidez (**) (mg/l) (Tu)	291,7±119,6 (75,8-610)	257,3±115,4 (75,8-610)	324,5±95,8 (100-561)	386,1±120,2 (182,3-610)	9,3, p<0,001 (N-H)
pH (**) (pH)	7,8±0,4 (7,1-9)	7,9±0,3 (7,2-8,8)	7,5±0,4 (7,1-8,5)	7,5±0,4 (7,2-9)	20,3, p<0,001 (N-H)
Canal (Ca)					
Anchura (**) (cm) (Ac)	256,9±72,5 (150-450)	245,7±71,4 (150-450)	265,2±71,2 (190-450)	292,8±71,3 (200-450)	3,4, p=0,04 (A-N, N-H)
Profundidad (**) (cm) (Pf)	58,1±17,4 (20-90)	54,5±17,4 (20-90)	60,7±15 (40-90)	69,6±16,8 (40-90)	5,3, p=0,006 (A-N, N-H)
Velocidad de la corriente (**) (1-4) (Vc)	2,3±0,8 (1-4)	2,4±0,8 (1-4)	2,1±0,7 (1-3)	2,3±0,8 (1-4)	n,s,

tos muestreados (mapa hidrográfico de la Reserva) y en cuadrículas UTM 10 x 10 km (mapa UTM de la Reserva). Dos índices biogeográficos fueron calculados para cada especie: área de ocupación (AO), definida como el tanto por ciento de cursos de agua (AOa) o de cuadrículas de 100 km^2 (AOc) donde aparece la especie, y distancia lineal (DL), definida como la mayor distancia entre cursos de agua (DLa) o cuadrículas de 100 km^2 (DLc) donde aparece la especie (GASTON, 1996; SEGURADO Y ARAUJO, 2004).

Para todas las especies se considerarán los siguientes criterios: especie de distribución puntual (AOa ≤ 10%, AOc ≤ 12%), especie de distribución restringida (AOa entre 11-50%, AOc entre 12,1-35%), especie de distribución amplia (AOa entre 51-99%, AOc entre 36-99%) y especie de distribución ubicua (AOa= 100% y AOc= 100%). Las poblaciones de especies de distribución puntual estarán cercanas cuando DLa ≤ 35 km, distantes cuando 36 < DLa < 90 km y muy distantes cuando DLa ≥ 91 km.

Sólo se tuvieron en cuenta los individuos vivos. Las localidades donde sólo se encontraron conchas vacías de gasterópodos o bivalvos fueron excluidas del análisis.

RESULTADOS

Hábitat

En la Tabla I se consignan los valores del hábitat del entorno de los cursos de agua analizados. Las características estructurales del medio marcan un gradiente muy definido de oeste a este, correspondiendo en todos los casos los valores máximos al entorno de la Sierra de Aracena y Picos de Aroche. El balance hídrico es, igualmente, diferente a lo largo del eje principal de la Reserva (test de Wilks, $F_{(8,206)}$= 0,45, p<0,001), diferenciándose significativamente los parámetros climáticos de moderada influencia atlántica de la Sierra de Aracena y Picos de Aroche de los continentales y más estresados hídricamente de Sierra Norte y Sierra de Hornachuelos (test de Tukey, p<0,001 entre aquel y estos), no siendo significativas las diferencias entre estas dos últimas zonas.

Especies

La malacofauna de "Dehesas de Sierra Morena" está formada principalmente por especies paleárticas. Se han encontrado 18 especies vivas (14 gasterópodos y 4 bivalvos) en dicha zona, de las cuales 17 son autóctonas y 1 introducida (*Potamopyrgus antipodarum*) (Tabla II). Aunque se ha constatado la presencia de valvas vacías de *Anodonta anatina*, no se ha podido comprobar la presencia de individuos vivos en los cursos de agua de la Reserva.

Las correlaciones entre los valores de Re, Rg, Rb, Rf y H´e y los del medio son ampliamente significativas (p entre 0,01 y 0,001 en todos los casos). El grado de significación de Ae es, igualmente, variable aunque las correlaciones con QBR, Cm, H´s, Pd, Or, Ac, Pf y Vc no son estadísticamente significativas.

La riqueza específica oscila entre 2-9 (media 4,3±2,0 SD) y está íntimamente relacionada con la riqueza de gasterópodos (2-8, media 4,0±1,5 SD): r= 0,96, p<0,001. Las diferencias de riqueza específica entre los tres espacios protegidos del área de estudio son significativas, dependiendo, no obstante, dichas divergencias de las relaciones entre SA con SN y SH (test HSD de Tukey, p>0,05). Igualmente, los valores de riqueza de familias, abundancia y diversidad de Shannon-Wiener son significativamente mayores en el entorno de SA, no siendo significativas las diferencias entre los valores de SN y SH (test HSD de Tukey, p>0,05) (ver Tabla III).

Las especies de gasterópodos autóctonos se han encontrado en el 100% de los puntos muestreados, estando el orden Pulmonata representado en todos ellos y el Neotaenioglossa en el 29.3%. Los bivalvos se encuentran en el 28.4% de las localidades (la náyade *Unio* cf. *pictorum* sólo reside en el 3,7% del territorio). *Physella acuta*, *Ancylus fluviatilis* y *Planorbarius metidjensis* son simpátricas en toda la Reserva, *Pisidium casertanum* y *Arganiella wolfi* sólo lo son en su área de distribución (Parque Natural Sierra de Aracena y Picos de Aroche) (ver Figuras 2-20).

Tabla II. Especies de moluscos de agua dulce encontradas en "Dehesas de Sierra Morena". (*): sólo se encontraron valvas.
Table II. Freshwater mollusc species found in "Dehesas de Sierra Morena". (*): only valves were founded.

CLASE GASTROPODA
- Orden Neotaenioglossa
  - Familia Thiaridae
    - *Melanopsis praemorsa* (Linnaeus, 1758) (Mp)
  - Familia Hydrobiidae
    - *Arganiella wolfi* (Boeters & Glöer, 2007) (Aw)
    - *Potamopyrgus antipodarum* (J.E. Gray, 1843) (Pa)
- Orden Pulmonata
  - Familia Lymnaeidae
    - *Stagnicola palustris* (O.F. Müller, 1774) (Sp)
    - *Galba truncatula* (O.F. Müller, 1774) (Gt)
    - *Radix auricularia* (Linnaeus, 1758) (Ra)
    - *Radix balthica* (Linnaeus, 1758) (Rb)
  - Familia Physidae
    - *Physella (Costatella) acuta* (Draparnaud, 1805) (Pt)
  - Familia Planorbidae
    - *Planorbarius metidjensis* (Forbes, 1838) (Pm)
    - *Ferrissia (Pettancylus) clessiniana* (Jickeli, 1882) (Fc)
    - *Gyraulus (Gyraulus) albus* (O.F. Müller, 1774) (Ga)
    - *Gyraulus (Torquis) laevis* (Alder, 1838) (Gl)
    - *Hippeutis complanatus* (Linnaeus, 1758) (Hc)
    - *Ancylus fluviatilis* (O.F. Muller, 1774) (Af)

CLASE BIVALVIA
- Orden Unionida
  - Familia Unionidae
    - *Anodonta anatina** (Linnaeus, 1758) (Aa)
    - *Unio* cf. *pictorum* (Linnaeus, 1758) (Up)
  - Familia Sphaeriidae
    - *Musculium (Musculium) lacustre* (O.F. Müller, 1774) (Ml)
    - *Pisidium (Euglessa) casertanum* (Poli, 1791) (Pc)
    - *Pisidium (Euglessa) personatum* (Malm, 1855) (Pp)

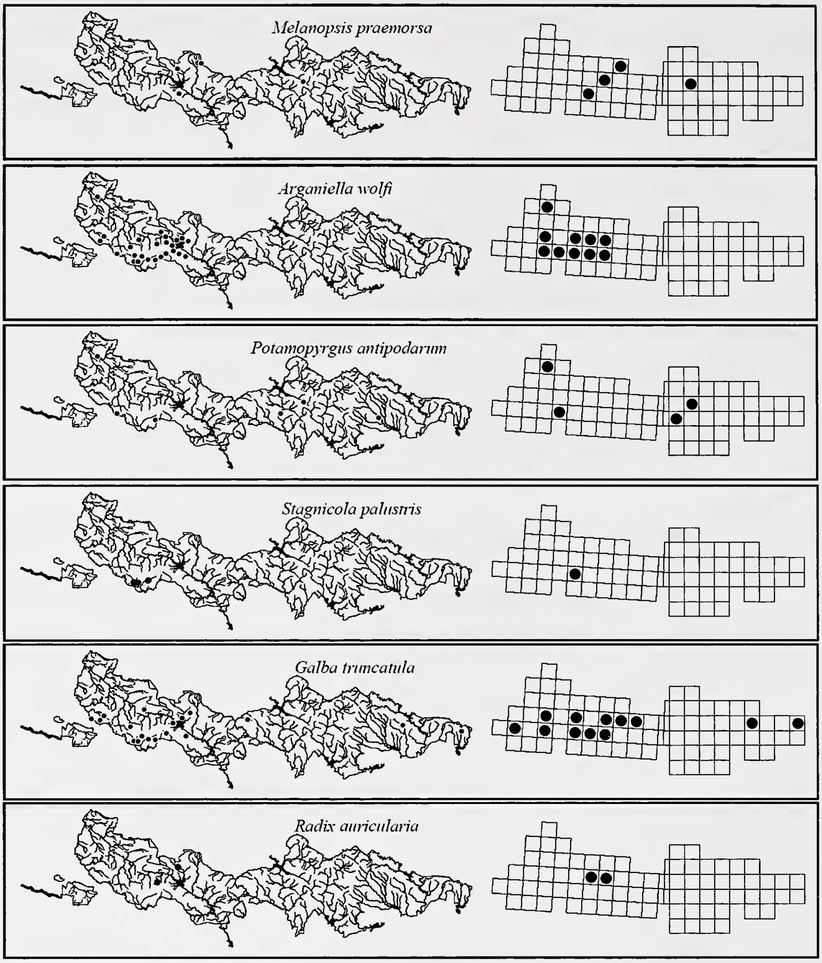
Distribución y preferencia de hábitat

Melanopsis praemorsa (Linnaeus, 1758)

Esta especie, aunque no incluida en el Libro Rojo de Invertebrados de España (Verdú y Galante, 2006), ha sido propuesta para ser catalogada a nivel nacional como especie "sensible a la alteración de su hábitat" (Gómez, Moreno, Rolán, Araujo y Álvarez, 2001). En Andalucía está considerada como especie vulnerable (Barea-Azcón, Ballesteros-Duperón y Moreno, 2008).

Distribución en la Península Ibérica: Nobre (1941); Alonso (1975a); Vidal-Abarca y Suárez (1985); Jiménez y Martínez (1988); Pujante, Tapia y Martínez (1998); Hinz *et al.* (1994); Gómez *et al.* (2001).

Distribución en la Reserva de la Biosfera (Fig. 2): especie de distribución puntual en SA y SN (Gasull, 1985; Pérez-Quintero *et al.*, 2004), con poblaciones dis-



2 3 4 5 6 7

Figuras 2-7. Distribución de las especies en los mapas geográficos y UTM de la Reserva.
Figures 2-7. Distribution of the species in the geographic and UTM Reserve maps.

tantes entre si. AOa= 4,6, AOc= 8.0, DLa= 58.7, DLc= 58.4.

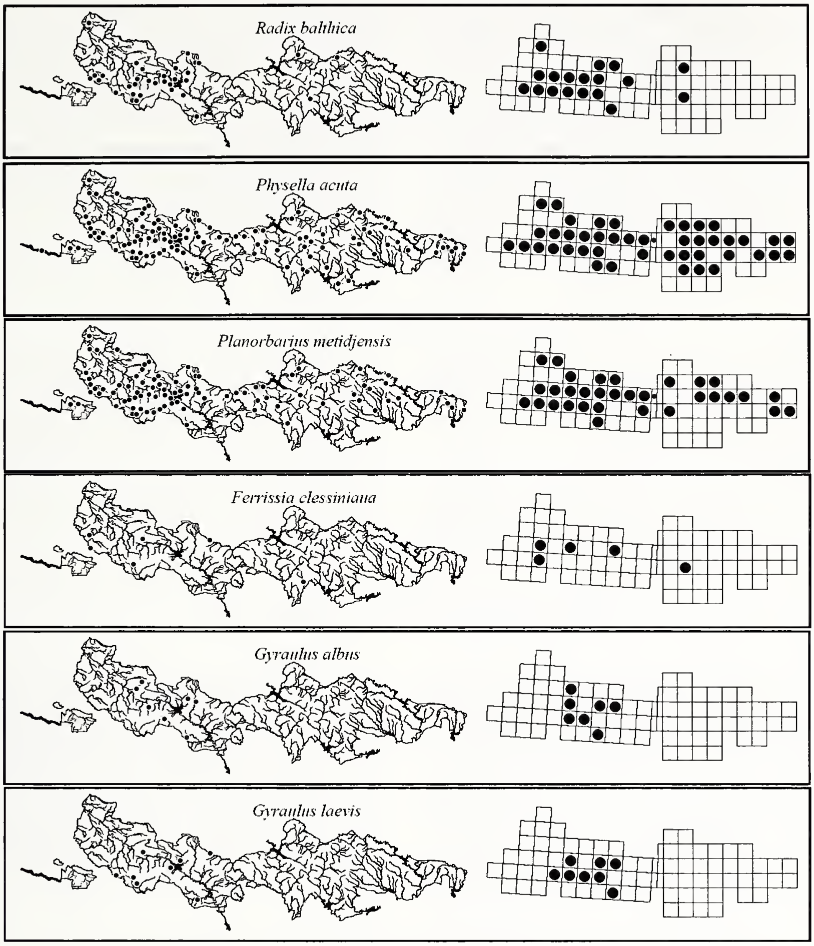
Preferencia de hábitat (valores medios): Ia (0,9), Pr (880,0), Sh (418.6), Dh (352,8), Cm (36.0), Pm (3,4), H´s (1,5), Al (457.0), Pd (2,2), Or (2,0), Co (317.6), Tu (211,0), pH (8.3), Ac (203,0), Pf (49.0).

Arganiella wolfi (Boeters y Glöer, 2007)

En Andalucía esta especie está considerada como especie vulnerable (Barea-Azcón *et al.*, 2008).

Distribución en la Península Ibérica: Bech y Altimira (2003); Pérez-Quintero *et al.* (2004); Arconada y Ramos (2007a,b); Boeters y Glöer (2007); Pérez-Quintero (2007).

Distribución en la Reserva de la Biosfera (Fig. 3): SA (Pérez-Quintero *et al.*, 2004; Arconada y Ramos, 2007a,b; Pérez-Quintero, 2007). Especie de dis-



Figuras 8-13. Distribución de las especies en los mapas geográficos y UTM de la Reserva.
Figures 8-13. Distribution of the species in the geographic and UTM Reserve maps.

tribución restringida a la zona central de la SA, con poblaciones cercanas. AOa= 22,0, AOc= 14,0, DLa= 47.6, DLc= 50,6.

Preferencia de hábitat: Ia (0,7), Pr (1079.1), Sh (599.5), Dh (325.5), Cm (36.9), Pm (3,6), H´s (1,5), Al (522,3), Pd (1,9), Or (1,2), Co (284,1), Tu (214,7), pH (7.9), Ac (218.3), Pf (50,6).

Nota: BECH Y ALTIMIRA (2003) describen la presencia de esta especie en Badajoz, nombrándola como *Valvata globulina*, mientras que PÉREZ-QUINTERO *ET AL.* (2004) y ARCONADA Y RAMOS (2007a) describen su presencia en la SA adscribiéndola a *Islamia minuta* y *Arganiella tartessica*, respectivamente.

Potamopyrgus antipodarum (J. E. Gray, 1853)

Distribución en la Península Ibérica: ALONSO (1975A); IBÁÑEZ Y ALONSO (1977); GONZÁLEZ, PUIG, TORT Y PRAT (1981); VIDAL-ABARCA Y SUÁREZ (1985);

BOETERS (1987); SIMÕES (1988); GRAÇA, FONSECA Y CASTRO (1989); BECH (1990); PUJANTE *ET AL.* (1998); HINZ *ET AL.* (1994); HERMIDA Y RODRÍGUEZ (1996); MARTÍNEZ-ORTÍ, APARICIO Y ROBLES (2004); SOLER, MORENO, ARAUJO Y RAMOS (2006); SOUSA, ANTUNES Y GUILHERMINO (2007).

Distribución en la Reserva de la Biosfera (Fig. 4): especie de distribución puntual en SA y SN (PÉREZ-QUINTERO *ET AL.*, 2004; PÉREZ-QUINTERO, 2007), con poblaciones muy distantes entre si. AOa= 5.5, AOc= 12,0, DLa= 128.7, DLc= 129.5.

Preferencia de hábitat: Ia (1,0), Pr (852,5), Sh (394,5), Dh (366.7), Cm (26.7), Pm (3,3), H´s (1,5), Al (373,0), Pd (1,7), Or (2,5), Co (444,0), Tu (294,3), pH (7.9), Ac (283,3), Pf (60,0).

Stagnicola palustris (O. F. Müller, 1774)

Distribución en la Península Ibérica: RAMOS Y APARICIO (1985); HINZ *ET AL.* (1994); SOLER *ET AL.* (2006); OLIVEIRA Y MARTÍNEZ-ORTÍ (2007).

Distribución en la Reserva de la Biosfera (Fig. 5): especie de distribución puntual en SA (PÉREZ-QUINTERO *ET AL.*, 2004) con poblaciones cercanas entre sí. AOa= 2,7, AOc= 2,0, DLa= 6.3, DLc= 0.

Preferencia de hábitat: Ia (0,7), Pr (1104,0), Sh (624,0), Dh (312,0), Cm (38.3), Pm (3,3), H´s (1,6), Al (560,0), Pd (1,7), Or (1,3), Co (264,7), Tu (211,7), pH (8.1), Ac (240,0), Pf (58.3).

Galba truncatula (O. F. Müller, 1774)

Distribución en la Península Ibérica: NOBRE (1941); SAMPAIO, FRAGA Y MATTOS (1973); ALONSO (1975A); VIDAL-ABARCA Y SUÁREZ (1985); BECH (1990); PUJANTE *ET AL.* (1998); HINZ *ET AL.* (1994); HERMIDA Y RODRÍGUEZ (1996); SOLER *ET AL.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 6): especie localizada en la SA, SN y SH, con distribución restringida y poblaciones muy distantes (PÉREZ-QUINTERO *ET AL.*, 2004). AOa= 19.3, AOc= 18.0, DLa= 187.4, DLc= 158.0.

Preferencia de hábitat: Ia (0,8), Pr (998.3), Sh (523,0), Dh (359.4), Cm (31,9), Pm (3,1), H´s (1,5), Al (468.9), Pd (1,9), Or (1,5), Co (298.4), Tu (245.4), pH (7.9), Ac (256.9), Pf (54,0).

Radix auricularia (Linnaeus, 1758)

Distribución en la Península Ibérica: NOBRE (1941); VALENTE Y VICENTE (1979); GRÁCIO (1983); GASULL (1985); RAMOS Y APARICIO (1985); VIDAL-ABARCA Y SUÁREZ (1985); JIMÉNEZ Y MARTÍNEZ (1988); BECH (1990); PUJANTE *ET AL.* (1998); HINZ *ET AL.* (1994); HERMIDA Y RODRÍGUEZ (1996); SOLER *ET AL.* (2006); SOUSA *ET AL.* (2007).

Distribución en la Reserva de la Biosfera (Fig. 7): especie de distribución puntual con poblaciones cercanas localizadas en SA (PÉREZ-QUINTERO *ET AL.*, 2004). AOa= 1,8, AOc= 4,0, DLa= 11,9, DLc= 11,8.

Preferencia de hábitat: Ia (0,8), Pr (993,5), Sh (523,0), Dh (331,5), Cm (40,0), Pm (4,0), H´s (1,5), Al (432,5), Pd (2,5), Or (1,5), Co (304,5), Tu (209.2), pH (8.1), Ac (245.0), Pf (47.5).

Radix balthica (Linnaeus, 1758)

Distribución en la Península Ibérica: NOBRE (1941); VALENTE Y VICENTE (1979); GRÁCIO (1983); RAMOS Y APARICIO (1985); VIDAL-ABARCA Y SUÁREZ (1985); JIMÉNEZ Y MARTÍNEZ (1988); BECH (1990); PUJANTE *ET AL.* (1998); HINZ *ET AL.* (1994);

Tabla III. Izquierda: Media ± Desviación Standard y rangos (entre paréntesis) de las medidas de biodiversidad en los tres espacios protegidos y en el conjunto de la Reserva de la Biosfera (B). Derecha: ANOVA entre zonas.
Table III. Mean ± Standard deviation and intervals (between parentheses) of the biodiversity measures in the three protected spaces and in the Biosphere Reserve as a whole (B). Right: ANOVA between zones.

	B	SA	SN	SH	$F_{(2,106)}$
Re	4,3±2 (2-9)	5.3±2 (3-9)	3±0.8 (2-5)	2,8±0.7 (2-4)	32,6, p<0.001 (2-3)
Rg	4±1.5 (2-8)	4,6±1.5 (3-8)	3±0.8 (2-5)	2,8±0.7 (2-4)	28.1, p<0.001 (2-3)
Rb	0.4±0.7 (0-3)	0.6±0.8 (0-3)	0.03±0.2 (0-1)	0	13, p<0.001 (2-3)
Rf	3±1.2 (2-7)	3,4±1.3 (2-7)	2,3±0.5 (2-4)	2,1±0.4 (2-3)	20.1, p<0.001 (2-3)
Ae	5.5±2,6 (0.6-14,6)	6.6±1.8 (2,7-14,4)	3,9±2,2 (0.6-11.7)	3,8±3,7 (1-14,6)	29.3, p<0.001 (2-3)
H´e	1.7±0.4 (0.5-2)	1.4±0.3 (0.6-2)	0.8±0.2 (0.5-1.2)	0.8±0.1 (0.6-1)	44, p<0.001 (2-3)

HERMIDA Y RODRÍGUEZ (1996); SOLER *ET AL.* (2006); SOUSA *ET AL.* (2007).

Distribución en la Reserva de la Biosfera (Fig. 8): especie de distribución restringida, con poblaciones localizadas principalmente en SA y escasas en SN (GASULL, 1985; PÉREZ-QUINTERO *ET AL.*, 2004; PÉREZ-QUINTERO, 2007). AOa= 35.8, AOc= 32,0, DLa= 119.0, DLc= 120,1.

Preferencia de hábitat: Ia (0,8), Pr (990,7), Sh (518.8), Dh (337.6), Cm (33,2), Pm (3,3), H´s (1,5), Al (505.4), Pd (1,9), Or (1,5), Co (324,4), Tu (233,5), pH (7.9), Ac (226.9), Pf (2,6).

Physella (Costatella) acuta (Draparnaud, 1805)

Distribución en la Península Ibérica: NOBRE (1941); MARAZANOF (1966); GRÁCIO (1983); RAMOS Y APARICIO (1985); VIDAL-ABARCA Y SUÁREZ (1985); JIMÉNEZ Y MARTÍNEZ (1988); GRAÇA *ET AL.* (1989); BECH (1990); PUJANTE *ET AL.* (1998); HINZ *ET AL.* (1994); HERMIDA Y RODRÍGUEZ (1996); SOLER *ET AL.* (2006); SOUSA *ET AL.* (2007).

Distribución en la Reserva de la Biosfera (Fig. 9): especie ubicua sintópica con *Ancylus fluviatilis* (GASULL, 1985; PÉREZ-QUINTERO *ET AL.*, 2004; PÉREZ-QUINTERO, 2007). AOa= 100, AOc= 100, DLa= 187.8, DLc= 188.3.

Preferencia de hábitat: Ia (1,0), Pr (864,5), Sh (404,5), Dh (386.7), Cm (25.4), Pm (2,7), H´s (1,4), Al (429.9), Pd (1,7), Or (1,8), Co (394,6), Tu (291,7), pH (7.7), Ac (257.0), Pf (58.1).

Planorbarius metidjensis (Forbes, 1838)

Distribución en la Península Ibérica: NOBRE (1941); FRAGA Y DO CARMO (1954); GRÁCIO (1983); VIDAL-ABARCA Y SUÁREZ (1985); VIDAL-ABARCA, GÓMEZ Y SUÁREZ (1991); HINZ *ET AL.* (1994); HERMIDA Y RODRÍGUEZ (1996); SOLER *ET AL.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 10): especie de distribución amplia con poblaciones en todos los entornos

protegidos de la Reserva (Ortiz de Zárate y Ortiz de Zárate, 1961; Gasull, 1985; Pérez-Quintero *et al.*, 2004; Pérez-Quintero, 2007). AOa= 81,6, AOc= 62,0, DLa= 178.4, DLc= 176.9.

Preferencia de hábitat: Ia (0,9), Pr (901,6), Sh (438.9), Dh (369.1), Cm (27.7), Pm (2,8), H´s (1,5), Al (443,5), Pd (1,8), Or (1,7), Co (386.3), Tu (279.4), pH (7.8), Ac (252,3), Pf (55.8).

Ferrissia (*Pettancylus*) *clessiniana* (Jickeli, 1882)

Distribución en la Península Ibérica: Vidal-Abarca y Suárez (1985); Bech (1990); Álvarez, Rico, Guerrero y Montes (2001); Soler *et al.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 11): especie de distribución puntual con poblaciones muy distantes localizadas en SA y SN (Pérez-Quintero *et al.*, 2004; Pérez-Quintero, 2007). AOa= 4,6, AOc= 8.0, DLa= 99.6, DLc= 100,2.

Preferencia de hábitat: Ia (1,0), Pr (838.6), Sh (373,6), Dh (362,6), Cm (22,0), Pm (3,0), H´s (1,4), Al (349.0), Pd (1,4), Or (2,6), Co (465.8), Tu (346.6), pH (7.7), Ac (338.0), Pf (67.0).

Gyraulus (*Gyraulus*) *albus* (O.F. Müller, 1774)

Distribución en la Península Ibérica: Nobre (1941); Marazanof (1966); Vidal-Abarca y Suárez (1985); Jiménez y Martínez (1988); Bech (1990); Pujante *et a*, (1998); Vidal-Abarca *et al.* (1991); Soler *et al.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 12): especie de distribución puntual con poblaciones cercanas en SA (Pérez-Quintero *et al.*, 2004; Pérez-Quintero, 2007). AOa= 6.4, AOc= 10,0, DLa= 33,0, DLc= 37.6.

Preferencia de hábitat: Ia (0,9), Pr (922,0), Sh (459.1), Dh (360,3), Cm (31,4), Pm (3,6), H´s (1,5), Al (412,8), Pd (2,4), Or (1,6), Co (349.1), Tu (236.3), pH (7.9), Ac (268.6), Pf (57.1).

Gyraulus (*Torquis*) *laevis* (Alder, 1838)

Distribución en la Península Ibérica: Marazanof (1966); Vidal-Abarca y Suárez (1985); Jiménez y Martínez (1988); Bech (1990); Pujante *et al.* (1998); Vidal-Abarca *et al.* (1991); Soler *et al.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 13): especie de distribución puntual con poblaciones cercanas en SA (Pérez-Quintero *et al.*, 2004; Pérez-Quintero, 2007). AOa= 9.2, AOc= 12,0, DLa= 42,8, DLc= 41,3.

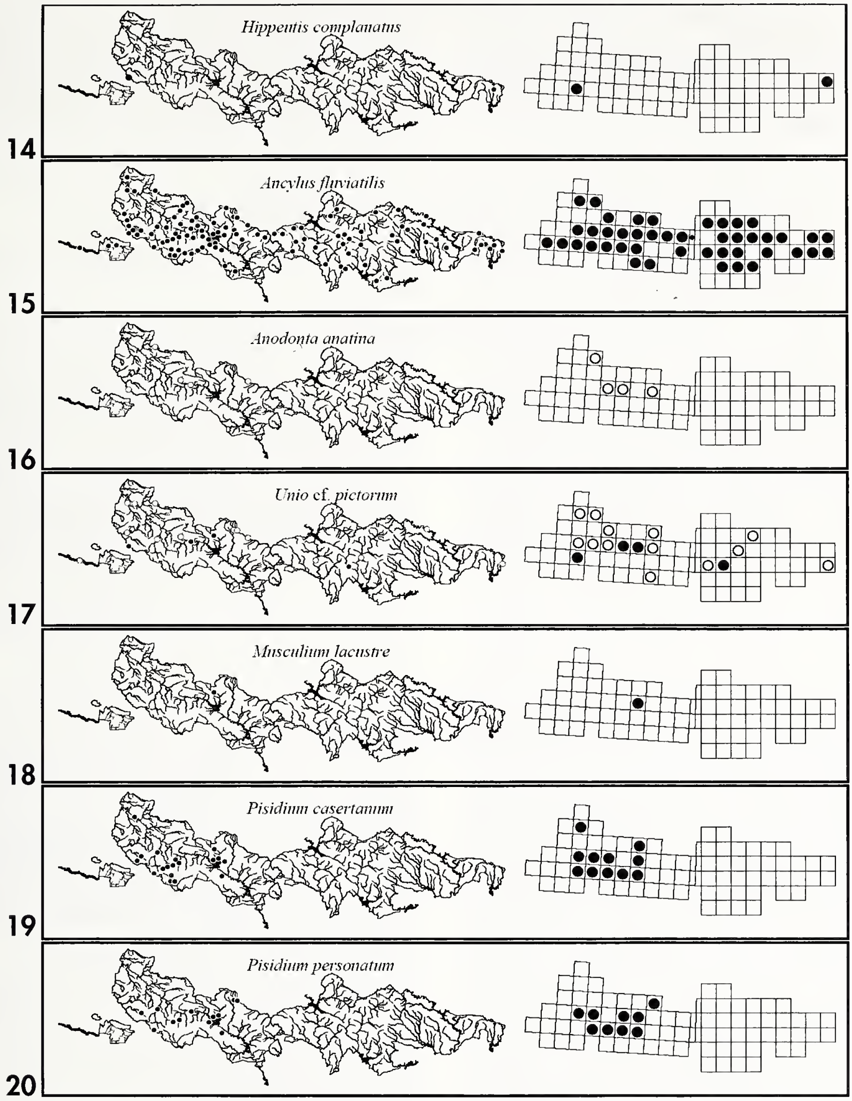
Preferencia de hábitat: Ia (0,7), Pr (1068.9), Sh (590,4), Dh (329.7), Cm (38.9), Pm (3,8), H´s (1,6), Al (547.2), Pd (1,9), Or (1,2), Co (273,5), Tu (233,0), pH (7.9), Ac (227.8), Pf (47.8).

Hippeutis complanatus (Linnaeus, 1758)

Distribución en la Península Ibérica: Nobre (1941); Marazanof (1966); Vidal-Abarca y Suárez (1985); Bech (1990); Pujante *et al.* (1998); Soler *et al.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 14): especie de distribución puntual con poblaciones muy distantes en SA y SH (Pérez-Quintero *et al.*, 2004; Pérez-Quintero, 2007). AOa= 1,8, AOc= 4,0, DLa= 164,8, DLc= 167.5.

Preferencia de hábitat: Ia (1,2), Pr (791,5), Sh (321,0), Dh (448.5), Cm (20,0), Pm (3,0), H´s (1,4), Al (231,5), Pd (1,0), Or (4,0), Co (451,0), Tu (41357), pH (7.6), Ac (350,0), Pf (65.0).



Figuras 14-20. Distribución de las especies en los mapas geográficos y UTM de la Reserva.
Figures 14-20. Distribution of the species in the geographic and UTM Reserve maps.

Ancylus fluviatilis (O. F. Muller, 1774)

Distribución en la Península Ibérica: NOBRE (1941); MARAZANOF (1966); ALONSO (1975A); GRÁCIO (1983); VIDAL-ABARCA Y SUÁREZ (1985); ROLÁN, VILAS Y NOMBELA (1987); JIMÉNEZ Y MARTÍNEZ (1988); BECH (1990); PUJANTE *ET AL*. (1998); RALLO Y RICO (1993); HINZ *ET AL*. (1994); MARTÍNEZ-ORTÍ *ET AL*. (2004); SOLER *ET AL*. (2006); SOUSA *ET AL*. (2007).

Distribución en la Reserva de la Biosfera (Fig. 15): especie ubicua sintópica con

Physella acuta (Ortiz de Zárate y Ortiz de Zárate, 1961; Gasull, 1985; Pérez-Quintero *et al.*, 2004; Pérez-Quintero, 2007). AOa= 100, AOc= 100, DLa= 187.8, DLc= 188.3.

Preferencia de hábitat: Ia (1,0), Pr (864,5), Sh (404,5), Dh (386.7), Cm (25.4), Pm (2,7), H´s (1,4), Al (429.9), Pd (1,7), Or (1,8), Co (394,6), Tu (291,7), pH (7.7), Ac (257.0), Pf (58.1).

Anodonta anatina (Linnaeus, 1758)

Esta especie, aunque no incluida en el Libro Rojo de Invertebrados de España (Verdú y Galante, 2006), ha sido propuesta para ser catalogada a nivel nacional como especie "de interés especial" (Gómez *et al*, 2001). En Andalucía está considerada como especie casi amenazada (Barea-Azcón *et al.*, 2008).

Distribución en la Península Ibérica: Altaba (1980); Altimira (1968); Araujo, Bragado y Ramos (2000); Araujo (2004); Bech y Altimira (2003); Galhano y Ferreira (1983); Gasull (1981); Gasull (1985); Moura, Vilarinho, Guedes y Machado (2000); Pérez-Quintero, 2007; Sousa *et al.*, 2007.

Distribución en la Reserva de la Biosfera (Fig. 16): no se han encontrado individuos vivos, sólo valvas en cursos de agua de SA: Arroyo Borbolluela, Arroyo Sillo, Rivera de Cala, Rivera de Huelva y Rivera del Chanza (ver Figura 16).

Preferencia de hábitat: los cursos de agua donde se han encontrado los restos de esta especie tienen las siguientes características: Ia (0,9), Pr (904,7), Sh (436.8), Dh (358.2), Cm (20,8), Pm (3,7), H´s (1,4), Al (370,0), Pd (1,3), Or (3,0), Co (407.7), Tu (277.2), pH (7.9), Ac (336.7), Pf (64,2).

Unio cf. *pictorum* (Linnaeus, 1758)

Esta especie, aunque no incluida en el Libro Rojo de Invertebrados de España (Verdú y Galante, 2006), ha sido propuesta para ser catalogada a nivel nacional como especie "en peligro de extinción" (Gómez, *et al.*, 2001). En Andalucía está considerada como especie "vulnerable" (Barea-azcón *et al.*, 2008).

Distribución en la Península Ibérica: Nobre (1941); Alonso (1975a); Vidal-Abarca y Suárez (1985); Gómez *et al.* (2001); Araujo (2004); Soler *et al.* (2006); Sousa *et al.* (2007).

Distribución en la Reserva de la Biosfera (Fig. 17): especie de distribución puntual con poblaciones muy distantes en SA y SN (Pérez-Quintero *et al.*, 2004). AOa= 3,7, AOc= 8.0, DLa= 99.5, DLc= 98.6.

Preferencia de hábitat: Ia (1,0), Pr (868.0), Sh (402,5), Dh (347.7), Cm (32,5), Pm (3,7), H´s (1,6), Al (355.2), Pd (1,7), Or (3,2), Co (401,0), Tu (263,6), pH (8.1), Ac (327.5), Pf (53,7).

Musculium (*Musculium*) *lacustre* (O. F. Müller, 1774)

Esta especie, aunque no incluida en el Libro Rojo de Invertebrados de España (Verdú y Galante, 2006), ha sido propuesta para ser catalogada a nivel nacional como especie "de interés especial" (Gómez *et al.*, 2001).

Distribución en la Península Ibérica: Vidal-Abarca y Suárez (1985); Gómez *et al.* (2001); Martínez-Ortí y Robles (2003); Araujo (2004); Soler *et al.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 18): especie de distribución puntual con una única población en SA (Pérez-Quintero *et al.*, 2004). AOa= 0,9, AOc= 2,0, DLa= 0, DLc= 0.

Preferencia de hábitat: Ia (0,9), Pr (883,0), Sh (422,0), Dh (351,0), Cm (40,0), Pm (4,0), H´s (1,6), Al (405.0), Pd (3,0), Or (2,0), Co (300,0), Tu (220,0), pH (8.2), Ac (290,0), Pf (45.0).

Pisidium (*Euglessa*) *casertanum* (Poli, 1791)

Distribución en la Península Ibérica: NOBRE (1941); KUIPER (1961); ALONSO (1975B); VIDAL-ABARCA Y SUÁREZ (1985); BECH (1990); HINZ *ET AL.* (1994); ARAUJO (1998); ARAUJO (2004); SOLER *ET AL.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 19): especie de distribución restringida en la SA (PÉREZ-QUINTERO *ET AL.*, 2004). AOa= 22,0, AOc= 18.0, DLa= 59.6, DLc= 51,2.

Preferencia de hábitat: Ia (0,7), Pr (1070,3), Sh (589.9), Dh (330,1), Cm (36.7), Pm (3,7), H´s (1,5), Al (530,6), Pd (2,0), Or (1,3), Co (319.3), Tu (231,6), pH (8.0), Ac (225.0), Pf (49.6).

Pisidium (*Euglessa*) *personatum* (Malm, 1855)

Distribución en la Península Ibérica: KUIPER (1961); ALONSO (1975B); VIDAL-ABARCA Y SUÁREZ (1985); BECH (1990); HINZ *ET AL.* (1994); ARAUJO (1998); ARAUJO (2004); SOLER *ET AL.* (2006).

Distribución en la Reserva de la Biosfera (Fig. 20): especie de distribución restringida en la SA (PÉREZ-QUINTERO *ET AL.*, 2004). AOa= 11,9, AOc= 14,0, DLa= 40,3, DLc= 44,0.

Preferencia de hábitat: Ia (0,7), Pr (1077.1), Sh (595.8), Dh (323,3), Cm (40,0), Pm (3,8), H´s (1,5), Al (525.0), Pd (1,9), Or (1,2), Co (287.9), Tu (213,1), pH (8.0), Ac (201,1), Pf (45.0).

CONCLUSIONES

En relación a las características del hábitat de la Reserva de la Biosfera sólo se conocen datos puntuales y muy generales del entorno (FRANCO, 1994; PRENDA, 1997; VILLA Y HERNÁNDEZ, 2003). En este estudio se analiza el gradiente que se establece entre los extremos occidental y oriental de la Reserva en función de cinco grupos de variables ambientales relacionadas con el entorno general y los cursos de agua en particular, estudiando cómo condicionan dichas variables la distribución de los moluscos dulceacuícolas.

Se examina por vez primera la biodiversidad malacológica dulceacuícola y su distribución en un entorno mediterráneo protegido del sur de la Península Ibérica (Dehesas de Sierra Morena, comunidad autónoma andaluza). Los datos previos son escasos y puntuales en el entorno de la Sierra de Aracena y Picos de Aroche (ORTIZ DE ZÁRATE Y ORTIZ DE ZÁRATE, 1961; GASULL, 1985; ARCONADA Y RAMOS, 2007B; ARCONADA, DELICADO Y RAMOS, 2007) y en el de la Sierra de Hornachuelos (ARCONADA Y RAMOS, 2006). PÉREZ-QUINTERO *ET AL.* (2004) describen la composición faunística del Parque Natural Sierra de Aracena y Picos de Aroche en un análisis provincial de las malacocenosis dulceacuícolas. A nivel regional PÉREZ-QUINTERO (2007) detalla la distribución y conservación de los moluscos dulceacuícolas de las subcuencas ibéricas del bajo Guadiana, incluyendo parte del entorno de la Sierra de Aracena y Picos de Aroche.

En relación a la biodiversidad una de las conclusiones más relevantes de este estudio es la descripción del gradiente en riqueza específica, abundancia y diversidad de Shannon-Wiener que se establece a lo largo del eje mayor de este entorno protegido. Este gradiente se organiza en función, fundamentalmente, de la disponibilidad hídrica y de los cambios en la heterogeneidad del medio a lo largo del eje oeste-este de la Reserva. En este estudio se amplía el área de distribución de las especies con carácter más euricoro, fundamentalmente los gasterópodos *Radix balthica, Physella acuta, Planorbarius metidjensis* y *Ancylus fluviatilis* y el bivalvo *Unio* cf. *pictorum*. Por otro lado se han encontrado nuevas localidades colonizadas por la especie invasora *Potamopyrgus antipodarum* y se presentan datos que confirman el carácter estenócoro de especies como *Melanopsis prae-*

morsa, Arganiella wolfi, Stagnicola palustris, Radix auricularia y ambas especies de *Pisidium,* todas ellas confinadas en entornos húmedos con cursos de agua estables a lo largo del ciclo anual.

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Fauna malacologica de un fondo detrítico fangoso en El Maresme, Barcelona (nordeste de la Península Ibérica)

Malacological fauna from a detritic muddy bottom in El Maresme, Barcelona (Nordeast of the Iberian Peninsula)

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RESUMEN

Se hace un listado de los moluscos marinos encontrados en un fondo detrítico fangoso en El Maresme, entre las localidades de Vilassar de Mar y Mataró, NE de la Península Ibérica. En total se han recogido 332 especies (5 poliplacóforos, 219 gasterópodos, 105 bivalvos y 3 escafópodos). Todo el material se obtuvo mediante varios dragados realizados entre los años 2001 y 2006. Se ha tratado de reconocer las especies que viven en ese tipo de fondo, por lo que en el listado se indican las especies recolectadas vivas y las que son fruto de tanatocenosis de fondos más costeros. Se hacen comentarios sobre algunas de estas especies, en especial sobre los de la superfamilia Galeommatoidea y se muestran fotografías de algunas de ellas. Seis especies se citan por primera vez para el Mediterráneo español.

ABSTRACT

The marine molluscs found in a detritic mud bottom in Maresme, between the localities of Vilassar de Mar and Mataró, NE of the Iberian Peninsula, are listed. In total, 332 species (5 Polyplacophora, 219 Gastropoda, 105 Bivalvia and 3 Scaphopoda) were collected. All the material was obtained from several dredgings made between the years 2001 and 2006. In order to know which species are living in this bottom, the list mentions which species were collected alive and which are thanatocaenosis originating from more coastal bottoms. Some comments on several species are made, mainly on the superfamily Galeommatoidea, showing photographs of some of them. Six species are the first record for the Spanish Mediterranean.

INTRODUCCIÓN

El presente trabajo trata sobre los moluscos marinos que se han encontrado en un fondo detrítico fangoso del piso circalitoral en el Maresme, entre las localidades de Vilassar de Mar y Mataró, al norte de la provincia de Barcelona, recolectados mediante dragados realizados entre los años 2001 y 2006, a una profundidad de unos 45 metros. El fondo estudiado cubre un área muy reducida en extensión pero muy rico en especies de moluscos, la mayoría de los cuales se encontraron vivos.

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Varios son los trabajos realizados sobre la fauna asociada a este tipo de fondos, pero no hemos encontrado ninguno referido a los moluscos en aguas del Mediterráneo español. ALONSO Y LÓPEZ-JAMAR (1988) solo tratan tangencialmente la malacofauna de estos fondos, centrándose en el estudio de los poliquetos.

ZONA DE ESTUDIO

El lugar objeto de estudio (Fig. 1) se encuentra a unos 45 metros de profundidad, a 5,5 kms de Mataró y 4,8 kms de Vilassar de Mar (41º 29′ 04″ N, 2º 29′ 05″ E), al norte de la provincia de Barcelona. Se trata de una zona en mar abierto, sin áreas abrigadas cercanas, ni tampoco fondos rocosos cercanos. Los fondos, entre el área de la biocenosis estudiada y la costa, lo forman, en primer lugar, la zona litoral, constituida por arenas más bien gruesas. A continuación, entre los 8 y 20 metros de profundidad, que en algún punto llega a los 24 m, se encuentra una extensa pradera de *Posidonia oceanica*, cuya fauna malacológica fue estudiada por PEÑAS Y ALMERA (2001). Entre esta pradera y la zona de estudio se encuentra un fondo de arenas relativamente gruesas, con mayor proporción de fango a medida que aumenta la profundidad, poblado en parte por *Cymodocea nodosa* en la zona más próxima a la pradera de *P. oceanica.*

Se tomaron también varias muestras a mayor profundidad del área objeto de este estudio, hasta los 65 metros, cuyos resultados no se reflejan aquí, pero se constató que entre los 50 y 65 metros de profundidad apenas se encontraban especies vivas, tampoco moluscos, ni siquiera bivalvos, y la mayoría de las conchas o restos encontrados eran subfósiles.

El fondo estudiado es detrítico fangoso, con predominio del fango sobre las arenas (PÉRÉS, 1982), las cuales son silíceas, de granulometría fina. También se encuentran fragmentos de conchas, mayoritariamente de bivalvos, así como restos de erizos, crustáceos, briozoos, escamas y espinas de peces y foraminíferos. La mayor proporción de materia orgánica obtenida es vegetal, formada por hojas y raices procedentes de las cercanas praderas de *Cymodocea nodosa* y, en menor cantidad, de *Posidonia oceanica.*

En esta biocenosis, rica en biodiversidad, se han encontrado vivas gran número de especies de invertebrados, además de moluscos. Entre ellas, son comunes la *Holothuria tubulosa* Gmelin, 1790, el erizo *Spatangus purpureus* (O. F. Müller, 1776), la estrella *Astropecten irregularis* (Pennant, 1777), los ofiuros *Ophiura albida* Forbes, 1839 y *Ophiura texturata* Lamarck, 1816, crustáceos del género *Ebalia*, los serpúlidos *Serpula vermicularis* (Linnaeus, 1767) y *Spirorbis pagenstecheri* (Quatrefages, 1865). Son abundantes el gusano poliqueto *Ditrupa arietina* (O. F. Müller, 1776), el sipuncúlido *Phascolion strombi* (Montagu, 1804), anfípodos de la superfamilia Gammaridea y el ascidiáceo *Ascidia conchilega* (O. F. Müller, 1776), especie que aporta el mayor volumen de biomasa animal obtenida.

MATERIAL Y MÉTODOS

El presente trabajo está basado en el material recolectado por los autores entre los años 2001 y 2006, mediante 12 dragados, todos realizados en los meses de Julio y Agosto, salvo uno, que se hizo en Abril de 2003. Las muestras se tomaron desde una pequeña embarcación pesquera, denominada BOLERA, del tipo "llagut". Los nueve primeros muestreos se hicieron mediante una pequeña draga rectangular de malla metálica, de dimensiones 0,6 m de ancho por 1 m de fondo y 0,25 m de altura, y los 3 últimos mediante una draga de arco, de 0,6 m, con una red de 1 m de larga, con una luz de malla de 1 mm. La draga se izaba manualmente y en cada jornada de dragado, una vez desechado el fango y arenas finas, se obtuvieron unos 20 litros de sedimentos, casi un 80% de cuyo volumen lo constituían restos vegetales.

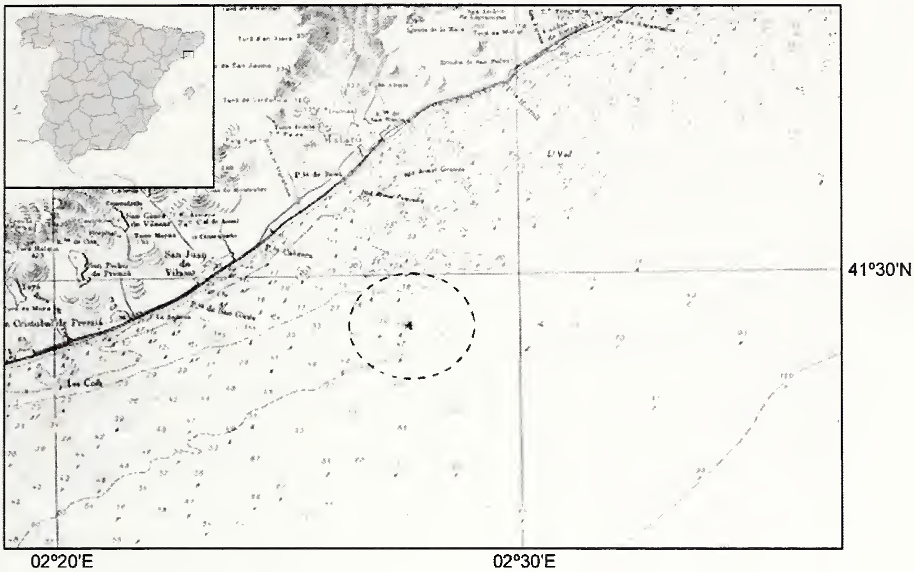


Figura 1. Mapa de la zona de muestreo.
Figure 1. Map of the sampling area.

Todo el material estudiado e ilustrado se encuentra depositado en la colección del primer autor, por lo que no se menciona este dato en el material estudiado ni en las representaciones fotográficas.

Se han fotografiado varias especies, la mayoría al microscopio electrónico de barrido (MEB), por su rareza o por aportar información adicional.

Las medidas que se aportan en las figuras son la altura para los gasterópodos y la longitud para las bivalvas.

El listado de especies ha sido confeccionado básicamente de acuerdo con la nomenclatura de la CLEMAM (Check List of European Marine Mollusca: http://www.somali.asso.fr/clemam/biotaxis.php).

Abreviaturas utilizadas:

BMNH Nacional History Museum, London
MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Muséum National d'Histoire Naturelle, París
c: concha
e: ejemplar encontrado vivo, o con restos de partes blandas
v: valva

RESULTADOS

El número total de especies de moluscos marinos recogidos en este trabajo es de 332 (5 poliplacóforos, 219 gasterópodos, 105 bivalvos y 3 escafópodos). De ellas, se han encontrado 213 especies vivas (4 poliplacóforos, 122 gasterópodos, 85 bivalvos y 2 escafópodos); por tanto, consideramos que la mayoría de ellas viven asociadas a este tipo de fondos.

El listado de las especies se recoge en la Tabla I. A la izquierda aparece el nombre de cada especie, que irá en negrita en el caso de que sea objeto de comentarios en la discusión; irá precedida de un asterisco (*) cuando constituya primera cita para el Mediterráneo español. A continuación se señala la abundancia relativa: +: solo encontrados 1-2 ejemplares en el total de muestreos;

Tabla I. Listado de las especies encontradas en el área de estudio. Las especies en negrita se comentan en el texto. Códigos: *: primera cita para el Mediterráneo español; +: 1-2 ejemplares; ++: 3-10 ejemplares; +++: especie común, entre 11 y 100 ejemplares; ++++: abundante, más de 100 ejemplares, encontrada en todos los muestreos; m: solo encontradas conchas vacías o valvas, en el caso de bivalvos.

*Table I. List of the species found in the study area. The species in bold are commented in the text. Code: *: first record for the Spanish Mediterranean; +: 1-2 specimens; ++: 3-10 specimens; +++: common species, between 11 and 100 specimens; ++++: very common, more than 100 specimens, found in all the samplings; m: only empty shells of valves, in the case of bivalves.*

Clase POLYPLACOPHORA			
Familia LEPTOCHITONIDAE			
* ***Leptochiton cimicoides*** **(Monterosato, 1879)**	++		Figs. 2-4
Familia HANLEYIDAE			
Hanleya hanleyi (Bean in Torpe, 1844)	++		
Familia ISCHNOCHITONIDAE			
Callochiton calcatus **Dell'Angelo y Palazzi, 1994**	++		Fig. 5
Callochiton septemvalvis (Montagu, 1803)	++		
Familia ACANTHOCHITONIDAE			
Acanthochitona fascicularis (Linnaeus, 1767)	++	m	
Clase GASTROPODA			
Familia ACMAEIDAE			
Acmaea virginea (O. F. Müller, 1776)	++		
Familia LEPETELLIDAE			
Lepetella espinosae Dantart y Luque, 1994	+++		
Familia NERITIDAE			
Smaragdia viridis (Linnaeus, 1758)	++	m	
Familia FISSURELLIDAE			
Diodora gibberula (Lamarck, 1822)	++	m	
Emarginula adriática (O. G. Costa, 1829)	++	m	
Emarginula fisura (Linnaeus, 1758)	++	m	
Emarginula rosea T. Bell, 1824	++	m	
Emarginula sicula J. E. Gray, 1825	++	m	
Familia SCISSURELLIDAE			
Scissurella costata d'Orbigny, 1824	+++		
Familia TROCHIDAE			
Clanculus cruciatus (Linnaeus, 1758)	+	m	
Jujubinus exasperatus (Pennant, 1777)	++	m	
Jujubinus montagui (W. Wood, 1828)	++++		
Gibbula fanulum (Gmelin, 1791)	++		
Gibbula guttadauri (Philippi, 1836)	++	m	
Gibbula magus (Linnaeus, 1758)	++		
Calliostoma conulus (Linnaeus, 1758)	++		
Calliostoma granulatum (Von Born, 1778)	+++		
Calliostoma zizyphinum (Linnaeus, 1758)	+		
Familia TURBINIDAE			
Bolma rugosa (Linnaeus, 1767)	++		
Familia TRICOLIIDAE			
Tricolia pullus pullus (Linnaeus, 1758)	++	m	
Tricolia speciosa (Von Mühlfeldt, 1824)	++	m	
Familia CERITHIIDAE			
Cerithium vulgatum Bruguière, 1792	++	m	

Tabla I. Continuación.
Table I. Continuation.

Bittium latreillii (Payraudeau, 1826)	++++		
Bittium reticulatum (da Costa, 1778)	++	m	
Bittium submamillatum (de Rayneval y Ponzi, 1854)	+++		
Familia TURRITELLIDAE			
Turritella communis Risso, 1826	++++		
Turritella turbona Monterosato, 1877	+++		
Familia TRIPHORIDAE			
Monophorus perversus (Linnaeus, 1758)	+	m	
Marshallora adversa (Montagu, 1803)	++		
Pogonodon pseudocanaricus (Bouchet, 1985)	++	m	
Metaxia metaxae (delle Chiaje, 1828)	+	m	
Familia CERITHIOPSIDAE			
***Cerithiopsis barleei* Jeffreys, 1867**	+++		Fig. 9
Cerithiopsis diadema Monterosato, 1874	++		
Cerithiopsis fayalensis Watson, 1886	++		
Cerithiopsis minima (Brusina, 1865)	++	m	
Cerithiopsis scalaris Locard, 1892	++	m	
***Cerithiopsis* sp.**	+	m	Figs. 6, 7
Cerithiopsis tubercularis (Montagu, 1803)	++		Fig. 8
Familia ACIDIDAE			
Aclis ascaris (Turton, 1819)	+	m	
Aclis minor (Brown, 1827)	++	m	
Familia EPITONIIDAE			
Epitonium aculeatum (Allan, 1818)	+++		
Epitonium algerianum (Weinkauff, 1866)	++	m	
Epitonium commune (Lamarck, 1822)	+	m	
Epitonium linctum (de Boury y Monterosato, 1890)	+		
Epitonium turtonis (Turton, 1819)	++		
Opalia crenata (Linnaeus, 1758)	++	m	
Opalia hellenica (Forbes, 1844)	++	m	
Acirsa subdecussata (Cantraine, 1835)	++		
Familia EULIMIDAE			
Eulima bilineata Alder, 1848	+++		
Eulima glabra (da Costa, 1778)	++		
Crinphtheiros comatulicola (Graff, 1875)	++		
Curveulima devians (Monterosato, 1884)	+	m	
Ersilia mediterranea (Monterosato, 1869)	+	m	
Melanella frielei (Jordan, 1895)	+++		
Melanella monterosatoi (Monterosato, 1890)	++		
Melanella polita (Linnaeus, 1758)	+++		
Melanella compactilis (Locard, 1892)	++		
Sticteulima jeffreysiana (Brusina, 1869)	++		
Vitreolina curva (Monterosato, 1874)	+++		
Vitreolina perminima (Jeffreys, 1883)	+++		
Vitreolina philippi (de Rayneval y Ponzi, 1854)	+++		
Familia RISSOIDAE			
Rissoa auriscalpium (Linnaeus, 1758)	+	m	
Rissoa guerinii Récluz, 1843	++	m	

Tabla I. Continuación.
Table I. Continuation.

Rissoa ventricosa Desmarest, 1814	++	m
Rissoa violacea Desmarest, 1814	++	m
Pusillina inconspicua (Alder, 1844)	++++	
Pusillina philippi (Aradas y Maggiore, 1844)	++	m
Alvania beani (Hanley in Thorpe, 1844)	+++	m
Alvania cancellata (da Costa, 1778)	++	m
Alvania cimex (Linnaeus, 1758)	+	m
Alvania geryonia (Nardo, 1847)	+++	m
Alvania hispidula (Monterosato, 1884)	++	m
Alvania punctura (Montagu, 1803)	+++	
Alvania subcrenulata (Bucquoy, Dautzenberg y Dollfus, 1884)	+	m
Alvania tenera (Philippi, 1844)	+	m
Alvania testae (Aradas y Maggiore, 1844)	++	
Alvania zetlandica (Montagu, 1805)	++	m
Crisilla semistriata (Montagu, 1808)	+	m
Manzonia crassa (Kanmacher, 1798)	+	m
Obtusella intersecta (S. Wood, 1857)	+++	m
Obtusella macilenta (Monterosato, 1880)	+++	
Familia ADEORBIDAE		
Circulus tricarinatus (S. Wood, 1848)	++	
Familia CAECIDAE		
Caecum subanulatum de Folin, 1870	++	
Caecum trachea (Montagu, 1803)	++++	
Familia IRAVADIIDAE		
Ceratia proxima (Forbes y Hanley, 1850)	+++	
Hyala vitrea (Montagu, 1803)	+++	
Familia VERMETIDAE		
Vermetus rugulosus Monterosato, 1878	++	m
Familia APORRHAIIDAE		
Aporrhais pespelicani (Linnaeus, 1758)	++++	
Familia CALYPTRAEIDAE		
Calyptraea chinensis (Linnaeus, 1758)	++++	
Crepidula unguiformis Lamarck, 1822	+++	
Familia CAPULIDAE		
Capulus ungaricus (Linnaeus, 1758)	+++	
Familia LAMELLARIIDAE		
Lamellaria latens (O. F. Müller, 1776)	++	m
Familia TRIVIIDAE		
Trivia arctica (Pulteney, 1799)	++	m
Familia ERATOIDAE		
Erato voluta (Montagu, 1803)	+++	
Familia OVULIDAE		
Neosimnia spelta (Linnaeus, 1758)	++	
Pseudosimnia carnea (Poiret, 1789)	++	
Familia NATICIDAE		
Euspira macilenta (Philippi, 1844)	+++	
Euspira pulchella (Risso, 1826)	+++	
Familia ATLANTIDAE		
Atlanta fusca Souleyet, 1852	++	m

Tabla I. Continuación.
Table I. Continuation.

Familia MURICIDAE			
Bolinus brandaris (Linnaeus, 1758)	++		
Hadriania craticuloides (Vokes, 1964)	++		
Hexaplex trunculus (Linnaeus, 1758)	+++		
Muricopsis aradasii (Poirier, 1883 ex Monterosato ms.)	+		
Muricopsis cristata (Brocchi, 1814)	+	m	
Ocenebra erinacea (Linnaeus, 1758)	+	m	
Ocinebrina aciculata (Lamarck, 1822)	++		
Trophon muricatus (Montagu, 1803)	++++		
Familia CORALLIOPHILIDAE			
Coralliophila brevis (de Blainville, 1832)	++		
Coralliophila squamosa (Ant. Bivona in And. Bivona, 1838)	++		
Familia FASCIOLARIIDAE			
Fusinus pulchellus (Philippi, 1844)	+++		
Fusinus rostratus (Olivi, 1792)	++		
Familia BUCCINIDAE			
Chauvetia brunnea (Donovan, 1804)	+	m	
Familia NASSARIIDAE			
Nassarius incrassatus (Ström, 1768)	++	m	
Nassarius pygmaeus (Lamarck, 1822)	++++		
Cyclope pellucida Risso, 1826	+	m	
Familia COLUMBELLIDAE			
Mitrella minor (Scacchi, 1836)	++		
Familia CYSTISCIDAE			
Gibberula caelata (Monterosato, 1877)	++	m	
Gibberula miliaria (Linnaeus, 1758)	+	m	
Familia CANCELLARIIDAE			
Cancellaria similis G. B. Sowerby, 1833	++		
Familia DRILLIIDAE			
Crassopleura maravignae (Ant. y And. Bivona, 1838)	++		
Familia TURRIDAE			
Haedropleura septangularis (Montagu, 1803)	++	m	
Familia CONIDAE			
Comarmondia gracilis (Montagu, 1803)	++++		
Mitrolumna olivoidea (Cantraine, 1835)	+	m	
Drilliola emendata (Monterosato, 1872)	+	m	
Bela brachystoma (Philippi, 1844)	++++		Figs. 10, 11
Bela clarae Peñas y Rolán, 2008	+++		
Bela fuscata (Deshayes, 1835)	++		Figs. 12, 13
Bela menkhorsti van Aartsen, 1988	+++		
Bela nebula (Montagu, 1803)	++++		Figs. 14, 15
Bela ornata (Locard, 1892)	++	m	Figs. 16-18
Mangelia costata (Donovan 1804)	+++		
Mangelia costulata (Risso, 1826)	++++		
Mangelia nuperrima (Tiberi, 1855)	++		
Mangelia tenuicostata Brugnone, 1868	+++		
Mangelia unifasciata Deshayes, 1835	++++		
Mangelia vauquelini (Payraudeau, 1826)	+	m	
Raphitoma aequalis Jeffreys, 1867	+++		Fig. 22
Raphitoma concinna (Scacchi, 1836)	+	m	

Tabla I. Continuación.
Table I. Continuation.

Raphitoma corbis (Potiez y Michaud, 1838)	++	m	
Raphitoma cordieri (Payraudeau, 1826)	++		Fig. 23
Raphitoma echinata (Brocchi, 1814)	+++		Fig. 24
Raphitoma linearis (Montagu, 1803)	++	m	
Teretia teres (Reeve, 1844)	+++		
Familia ARCHITECTONICIDAE			
Basisulcata lepida (Bayer, 1942)	++		
Heliacus subvariegatus (d'Orbigny, 1852)	++	m	
Philippia hybrida (Linnaeus, 1758)	+	m	
Pseudotorinia architae (O. G. Costa, 1841)	+++		
Familia OMALOGYRIDAE			
Retrotortina fuscata Chaster, 1896	+	m	
Familia PYRAMIDELLIDAE			
Chrysallida clathrata (Jeffreys, 1848)	+++		
Chrysallida dollfusi (Kobelt, 1903)	+		
Chrysallida emaciata (Brusina, 1866)	+++		
Chrysallida fenestrata (Jeffreys, 1848)	++		
Chrysallida interstincta (J. Adams, 1797)	++	m	
Chrysallida juliae (de Folin, 1872)	++	m	
Chrysallida multicostata (Jeffreys, 1884)	+++		Figs. 25, 26
Chrysallida palazzii Micali, 1984	++		
Chrysallida suturalis (Philippi, 1844)	++		
Chrysallida terebellum (Philippi, 1844)	+	m	
***Eulimella acicula* (Philippi, 1836)**	+++		Figs. 27, 28
Eulimella bogii van Aartsen, 1995	+	m	
Eulimella scillae (Scacchi, 1835)	+		
Eulimella ventricosa (Forbes, 1844)	+++	m	
Syrnola minuta (H. Adams, 1869)	++		
Megastomia conoidea (Brocchi, 1814)	++++		
Megastomia conspicua (Alder, 1850)	++		
Odostomia acuta Jeffreys, 1848	++++		
Odostomia angusta Jeffreys, 1867	+++		
Odostomia clavulus (Lovén, 1846)	+++		
Odostomia kromi van Aartsen, Menkhorst y Gittenberger, 1984	+	m	
Odostomia unidentata (Montagu, 1803)	+++		
Odostomia turriculata Monterosato, 1869	++	m	
Odostomia turrita Hanley, 1844	++		
Ondina crystallina Locard, 1892	+	m	
Ondina dilucida (Monterosato, 1884)	+++		
Ondina warreni (W. Thompson, 1845)	+++		
Turbonilla acutissima Monterosato, 1884	+++		
Turbonilla gradata Bucquoy, Dautzenberd y Dollfus, 1883	+	m	
Turbonilla jeffreysii (Forbes y Hanley, 1851)	+	m	
Turbonilla obliquata (Philippi, 1844)	+++		
Turbonilla postacuticostata Sacco, 1892	+	m	
Turbonilla pusilla (Philippi, 1844)	+	m	
***Turbonilla rufa* (Philippi, 1836)**	++++		Figs. 29-32
Turbonilla striatula (Linnaeus, 1758)	++	m	
Bacteridium carinatum (de Folin 1870)	+	m	

Tabla I. Continuación.
Table I. Continuation.

Familia ANISOCYCLIDAE			
Anisocycla gradata Monterosato, 1878	+	m	
Anisocycla nitidísima (Montagu, 1803)	++	m	
Familia TJAERNOIIDAE			
Tjaernoeia exquisita (Jeffreys, 1883)	+	m	
Familia ACTEONIDAE			
Acteon tornatilis (Linnaeus, 1758)	+++		
Familia DIAPHANIDAE			
***Diaphana* cf. *cretica* (Forbes, 1844)**	+	m	Figs. 35, 36
***Diaphana minuta* Brown, 1827**	++		Figs. 33, 34
Familia RETUSIDAE			
Retusa mammillata (Philippi, 1836)	++	m	
Retusa truncatula (Bruguière, 1792)	+	m	
Cylichnina crebrisculpta Monterosato, 1884	++++		
Cylichnina umbilicata (Montagu, 1803)	++		Figs. 37-39
Pyrunculus hoernesii (Weinkauff, 1866)	+	m	
Volvulella acuminata (Bruguière, 1792)	+++		
Familia RINGICULIDAE			
Ringicula conformis Monterosato, 1877	++++		
Familia HAMINOEIDAE			
Haminoea hydatis (Linnaeus, 1758)	++	m	
Atys jeffreysi (Weinkauff, 1866)	+	m	
Weinkauffia turgidula (Forbes, 1844)	+++		
Familia PHILINIDAE			
Philine angulata Jeffreys, 1867	++		
Philine aperta (Linnaeus, 1767)	++	m	
Philine intricata (Monterosato, 1875)	+++	m	
Philine scabra *(Müller, 1784)*	*+++*	*m*	
* ***Johania retifera* (Forbes, 1844)**	++		Figs. 40-43
* ***Laona flexuosa* (M. Sars, 1870)**	++		Fig. 44
***Laona pruinosa* (W. Clark, 1827)**	++		Figs. 45-46
Familia CYLICHNIDAE			
Cylichna cylindracea (Pennant, 1777)	+++		
Roxania utriculus (Brocchi, 1814)	+++		
Scaphander lignarius (Linnaeus, 1758)	+++		
Familia CAVOLINIDAE			
Cavolinia inflexa (Lesueur, 1813)	+++	m	
Clio pyramidata Linnaeus, 1767	++	m	
Creseis acicula Rang, 1828	++	m	
Creseis virgula Rang, 1828	++	m	
Familia LIMACINIDAE			
Limacina inflata (d'Orbigny, 1836)	++	m	
Familia PLEUROBRANCHIDAE			
Berthella sp.	+	m	
Familia UMBRACULIDAE			
Umbraculum mediterraneum (Lamarck, 1819)	++		
Familia APLYSIIDAE			
Aplysia depilans Gmelin, 1791	++		
Aplysia fascista Poiret, 1789	++		

Tabla I. Continuación.
Table I. Continuation.

Clase BIVALVIA			
Familia NUCULIDAE			
Nucula nitidosa Winckworth, 1930	++++		
Nucula sulcata Bronn, 1831	++		
Familia NUCULANIDAE			
Nuculana commutata (Philippi, 1844)	++++		
Nuculana pella (Linnaeus, 1767)	+++		
Familia ARCIDAE			
Arca tetragona Poli, 1795	++		
Barbatia clathrata (Defrance, 1816)	+	m	
Anadara corbuloides (Monterosato, 1878)	++		
Bathyarca pectunculoides (Scacchi, 1834)	++		
Bathyarca philippiana (Nyst, 1848)	++		
Familia NOETIIDAE			
Striarca lactea (Linnaeus, 1758)	+++		
Familia GLYCYMERIDAE			
Glycymeris bimaculata (Poli, 1795)	++		
Glycymeris glycymeris (Linnaeus, 1758)	++	m	
Familia MYTILIDAE			
Gregariella semigranata (Reeve, 1858)	++		
Musculus subpictus (Cantraine, 1835)	++++		
Musculus costulatus (Risso, 1826)	++		
Modiolus barbatus (Linnaeus, 1758)	++		
Modiolus adriaticus (Lamarck, 1819)	+++		
Modiolula phaseolina (Philippi, 1844)	++++		
Familia PECTINIDAE			
Pecten jacobeus (Linnaeus, 1758)	++		
Aequipecten commutatus (Monterosato, 1875)	++	m	
Aequipecten opercularis (Linnaeus, 1758)	+++		
Lissopecten hyalinus (Poli, 1795)	+		
Palliolum incomparabile (Risso, 1826)	++		
Similipecten similis (Laskey, 1811)	++++		
Crassadoma multistriata (Poli, 1795)	++		
Chlamys flexuosa (Poli, 1795)	++	m	
Chlamys pesfelis (Linnaeus, 1758)	+	m	
Chlamys varia (Linnaeus, 1758)	++		
Familia ANOMIIDAE			
Anomia ephippium Linnaeus, 1758	++++		
Pododesmus patelliformis (Linnaeus, 1761)	++		
Familia LIMIDAE			
Limea loscombii (G. B. Sowerby I, 1824)	+++		
Limatula subauriculata (Montagu, 1808)	+++		
Familia LUCINIDAE			
Lucinella divaricata (Linnaeus, 1758)	+++		
Anodonta fragilis (Philippi, 1836)	+++		
Myrtea spinifera (Montagu, 1803)	++++		
Lucinoma borealis (Linnaeus, 1767)	+++		
Familia THYASIRIDAE			
Thyasira alleni Carroza, 1981	++		Figs. 47-49
Thyasira biplicata (Philippi, 1836)	++++		

Tabla I. Continuación.
Table I. Continuation.

Thyasira croulinensis (Jeffreys, 1847)	+		
Familia UNGULINIDAE			
Diplodonta trigona (Scacchi, 1835)	+++		
Diplodonta rotundata (Montagu, 1803)	++	m	
Familia KELLIIDAE			
Kellia suborbicularis (Montagu, 1803)	+++		
Familia LEPTONIDAE			
Lepton squamosum (Montagu, 1803)	+	m	
Hemilepton nitidum (Turton, 1822)	+++		
***Litigiella glabra* (P. Fischer in de Folin y Périer, 1873)**	++	m	Figs. 50, 51
Familia MONTACUTIDAE			
***Montacuta ferruginosa* (Montagu, 1808)**	+++	m	Figs. 52, 53
* ***Montacuta goudi* van Aartsen, 1966**	+++		Figs. 54-57
***Montacuta semirubra* Gaglini, 1992**	+	m	Figs. 64, 65
***Montacuta substriata* (Montagu, 1808)**	+++		Figs. 66, 67
* ***Montacuta tenella* Lovén, 1846**	++	m	Figs. 68-70
***Kurtiella bidentata* (Montagu, 1803)**	++++		Figs. 71-73
***Kurtiella tumidula* (Jeffreys, 1866)**	++	m	Figs. 78-80
***Coracuta obliquata* (Chaster, 1897)**	++		Figs. 74-77
***Epilepton clarkiae* (W. Clark, 1852)**	+++		Figs. 81-83
***Mioerycina phascolionis* (Dautzenberg y Fischer, 1925)**	++	m	Figs. 58-63
Familia SPORTELLIDAE			
* ***Sportella recondita* (P. Fischer in de Folin, 1872)**	+	m	Figs. 84-86
Familia CARDITIDAE			
Glans aculeata (Poli, 1795)	++		
Familia ASTARTIDAE			
Astarte fusca (Poli, 1795)	++		
Astarte sulcata (da Costa, 1778)	+	m	
Goodallia triangularis (Montagu, 1803)	+++		
Familia CARDIIDAE			
Acanthocardia aculeata (Linnaeus, 1758)	++		
Acanthocardia echinata (Linnaeus, 1758)	++		
Acanthocardia paucicostata (G. B. Sowerby II, 1841)	+++		
Parvicardium minimum (Philippi, 1836)	++++		
Parvicardium scabrum (Philippi, 1844)	+++		
Plagiocardium papillosum (Poli, 1795)	+++		
Laevicardium crassum (Gmelin, 1791)	+++		
Laevicardium oblongum (Gmelin, 1791)	+	m	
Familia MACTRIDAE			
Spisula subtruncata (da Costa, 1778)	++++		
Familia PHARIDAE			
Phaxas pellucidus (Pennant, 1777)	++++		
Familia TELLINIDAE			
Tellina distorta Poli, 1791	+++		
Tellina incarnata Linnaeus, 1758	++	m	
Tellina serrata Brocchi, 1814	+++		
Arcopagia balaustina (Linnaeus, 1758)	+++		
Arcopagia crassa (Pennant, 1777)	++		
Familia DONACIDAE			
Capsella variegata (Gmelin, 1791)	++	m	

Tabla I. Continuación.
Table I. Continuation.

Familia PSAMMOBIIDAE			
Gari costulata (Turton, 1822)	++		
Gari fervensis (Gmelin, 1791)	+++		
Familia SEMELIDAE			
Ervilia castanea (Montagu, 1803)	+	m	
Abra alba (W. Wood, 1802)	++++		
Abra prismática (Montagu, 1808)	++++		
Familia SOLECURTIDAE			
Solecurtus scopula (Turton, 1822)	+		
Azorinus chamasolen (da Costa, 1778)	++		
Familia TRAPEZIIDAE			
Coralliophaga lithophagella (Lamarck, 1819)	++		
Familia VENERIDAE			
Venus casina Linnaeus, 1758	++		
Clausinella fasciata (da Costa, 1778)	+++		
Timoclea ovata (Pennant, 1777)	++++		
Gouldia minima (Montagu, 1803)	++++		
Dosinia lupinus (Linnaeus, 1758)	++++		
Pitar mediterranea (Tiberi, 1855)	+++		
Callista chione (Linnaeus, 1758)	++		
Paphia aurea (Gmelin, 1791)	+++		
Familia CORBULIDAE			
Corbula gibba (Olivi, 1792)	++++		
Familia HIATELLIDAE			
Hiatella arctica (Linnaeus, 1767)	+++		
Saxicavella jeffreysi Winkworth, 1930	+		
Familia XYLOPHAGIDAE			
Xylophaga dorsalis (Turton, 1819)	++		
Xylophaga praestans E. A. Smith, 1903	++	m	
Familia THRACIIDAE			
***Thracia papyracea* (Poli, 1791)**	++		Figs. 87-92
Thracia villosiuscula (MacGillivray, 1827)	+++		
Familia PANDORIIDAE			
Pandora pinna (Montagu, 1803)	++++		
Familia LYONSIIDAE			
***Lyonsia norwegica* (Gmelin, 1791)**	+++		Figs. 93-95
Familia POROMYIDAE			
Poromya granulata (Nyst y Westerdorp, 1839)	+		
Familia CUSPIDARIIDAE			
Cuspidaria cuspidata (Olivi, 1792)	+++		
Cuspidaria rostrata (Spengler, 1793)	+		
Cardiomya costellata (Deshayes, 1835)	+++		
Clase SCAPHOPODA			
Familia DENTALIIDAE			
Dentalium inaequicostatum Bucquoy, Dautzenb. y Dollfus, 1981	++++		
Dentalium panormum Chenu, 1858	++	m	
Familia GADILIDAE			
Dischides politus (S. Wood, 1842)	++++		

++: entre 3 y 10 ejemplares encontrados; +++: especie común, encontrada en casi todos los muestreos; ++++: especie abundante, numerosos ejemplares encontrados en todos los muestreos. En la siguiente columna se indican con una (m) las especies de las que sólo se han encontrado conchas vacías, o solo valvas, en el caso de bivalvos, indicando con ello que probablemente no habitan estos fondos. En la última columna se señalan con un número las especies ilustradas, indicando dicho número con el de la figura correspondiente.

DISCUSIÓN

Comentarios sobre algunos taxones

De la mayoría de especies aquí citadas existen fotografías y descripciones actualizadas en la literatura. En este apartado nos hemos limitado a comentar algunos taxones que nos han parecido de mayor interés, por su rareza o porque se aporta nueva información sobre ellos. De todas esas especies reportamos fotografías, la mayoría al microscopio electrónico de barrido (MEB).

Leptochiton cimicoides (Monterosato, 1879) (Figs. 2-4)

Chiton cimicoides Monterosato, 1879. *Gior. Sc. Nat. ed Econ.*, 14: 23 (nomen novum pro *Chiton minimus* Monterosato, 1878, non Gmelin, 1791 nec Spengler, 1797)
Lepidopleurus intermedius Salvini-Plawen, 1968. *Ann. Nat. Mus. Wien,* 72: 251, láms. 6-8, figs. 44-57.

Material examinado: 4 e.

MALUQUER (1915) cita esta especie como *Chiton minimus* Monterosato, 1872 para aguas cercanas del Golfo de León y Rosellón francés, pero la creía ausente de aguas de Cataluña. Se cita aquí por primera vez para el Mediterráneo español.

Callochiton calcatus Dell'Angelo y Palazzi, 1994 (Fig. 5)

Callochiton calcatus Dell'Angelo y Palazzi, 1994. *La Conchiglia,* 26 (273): 15, figs. 1-12, 14-19, 20B. [Localidad tipo: Villasimius, Cagliari, 80-100 m].
Chiton laevis var. *navicula* Jeffreys, 1865 (nomen dubium).

Material examinado: 2 e.

Esta especie la citan DELL'ANGELO Y SMRIGLIO (2001) para las Islas Baleares (Formentera) y consideran que probablemente vive asociada a algas calcáreas, sin embargo en la zona de estudio las arenas son silíceas, muy alejadas de fondos de maërl. Los ejemplares se encontraron sobre valvas vacías de bivalvos. Se cita aquí por primera vez para aguas de la Península Ibérica.

Cerithiopsis barleei Jeffreys, 1867 (Fig. 9)

Cerithiopsis barleei Jeffreys, 1867. *Brit. Conch.,* 4: 268.
Cerithiopsis acuminata Hallgas, 1985 ex Monterosato ms. *Notiz. CISMA,* 7 (1-2) 15, figs. 1-3.

Material examinado: 20 e en el área de estudio, más de 400 ejemplares en aguas próximas entre 25 y 100 m de profundidad.

Se confirma aquí el hábitat de esta especie, ya indicado por FRETTER Y GRAHAM (1982) y por LUGLI Y PALAZZI (1991), quienes, además, consideran C.

acuminata sinónimo junior de *C. barleei*. Todos los ejemplares aquí censados se encontraron viviendo dentro de la esponja *Suberites domuncula* (Olivi, 1792), de la que se alimentan. En ocasiones se han encontrado más de 10 ejemplares dentro de una esponja. Esta esponja se desarrolla sobre conchas ocupadas por el cangrejo ermitaño *Paguristes oculatus* (Fabricius, 1775).

Cerithiopsis sp. (Figs. 6, 7)

Material examinado: 1 c.

A primera vista esta concha parece una forma más pequeña de *C. tubercularis*, sin embargo la protoconcha presenta algunas diferencias, además de tener una menor altura: en *C. tubercularis* (Fig. 8) es lisa, con un cordoncillo, a modo de carena, justo sobre la sutura y un principio de costillas axiales justo bajo ella, mientras que en *C.* sp. sobre el cordoncillo suprasutural se encuenta un surco más ancho lleno de minúsculos gránulos. Otras especies, como *C. barleei* tienen una protoconcha diferente (Fig. 9). El hallazgo de una sola concha no nos permite apreciar diferencias suficientes para su descripción como nueva especie. El ejemplar mide 2.6 x 0.8 mm.

Género *Bela* Leach in Gray, 1847

Bela brachystoma (Philippi, 1844) (Figs. 10, 11). En este fondo es la especie más abundante entre los gasterópodos, de la que se han encontrado más de 600 especímenes y gran número de conchas.

Bela clarae Peñas y Rolán, 2008 y *Bela menkhorsti* van Aartsen, 1988. Ver en Peñas, Rolán y Ballesteros (2008) descripción de la primera y comentarios sobre ambas especies.

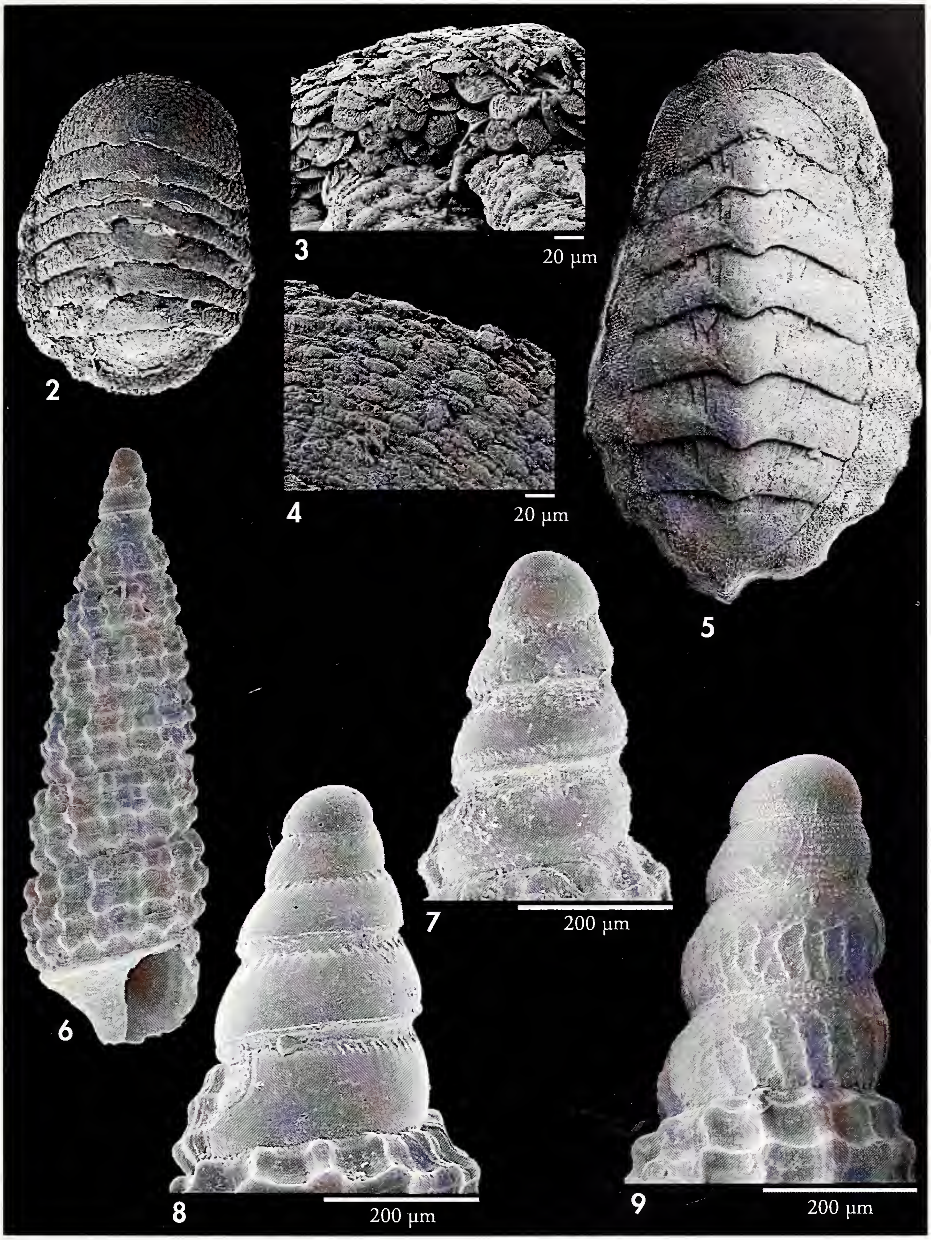
Bela laevigata (Philippi, 1836). No ha sido encontrado ningún ejemplar ni concha vacía en este fondo, ni tampoco en la cercana pradera de *P. oceanica* (Peñas y Almera, 2001). Después del estudio del material tipo de *Raphitoma zonata* Locard, 1892, ocho sintipos del MNHN, se considera que esta especie es sinónimo de *B. laevigata*. Se ilustran aquí tres conchas del material tipo (Figs. 19-21).

Bela ornata (Locard, 1892). Solamente se han encontrado 4 conchas de esta especie. Se ilustran aquí 3 sintipos del MNHN, procedentes de St. Raphael, Saint Tropez (Figs. 16-18).

Bela nebula (Montagu, 1803) (Figs. 14, 15). *Test. Brit.*, 267, lám. 15, fig. 6. Junto con *B. brachystoma* son las especies predominantes de este género y dominantes entre los gasterópodos en esta biocenosis, de la cual se han encontrado 180 ejemplares y más de 300 conchas. Pérès y Picard (1964) consideran esta especie "característica preferente" de fondos arenosos infralitorales denominados "Sables Fins Bien Calibrés" (SFBC). Picard (1965) la considera "característica exclusiva" y también Biagi y Corselli (1984), quienes constatan, además, que es el gasterópodo más abundante en un fondo SFBC del Golfo de Baratti, Italia. Sin embargo, la especie dominante de este género en fondos SFBC estudiados por nosotros en varias localidades del infralitoral catalán es *Bela laevigata* (Philippi, 1836).

Eulimella acicula Philippi, 1836 (Figs. 27, 28)

Melania acicula Philippi, 1836. *Enum. Mollusc. Sicil.*, 135. [Localidad tipo: Pleistoceno de Sicilia].
Pyramis laevis Brown, 1827. *Ill. Rec. Conch. G. Brit. and Ir.*, lám 50, figs. 51 y 52 (nomen dubium).
? *Eulima subcylindrata* Dunker in Weinkauff, 1862. *Jour. Conchyl.*, 10, 342, lám. 13, fig. 7.



Figuras 2-4. *Leptochiton cimicoides* (Monterosato, 1879). 2: concha, 1,6 mm; 3: detalle del perinoto; 4: detalle de la microescultura de las valvas. Fig. 5. *Callochiton calcatus* Dell'Angelo y Palazzi, 1994, concha, 5,6 mm. Figuras 6, 7. *Cerithiopsis* sp. 6: concha, 2,5 mm; 7: protoconcha. Figura 8. Protoconcha de *Cerithiopsis tubercularis* (Montagu, 1803). Figura 9. Protoconcha de *Cerithiopsis barleei* Jeffreys, 1867.

Figures 2-4. Leptochiton cimicoides *(Monterosato, 1879). 2: shell, 1.6 mm; 3: detail of girdle; 4: detail of valve microsculpture. Fig. 5.* Callochiton calcatus *Dell'Angelo and Palazzi, 1994, shell, 5.6 mm. Figures 6, 7.* Cerithiopsis *sp. 6: shell, 2.5 mm; 7: protoconch. Figura 8. Protoconch of* Cerithiopsis tubercularis *(Montagu, 1803). Figura 9. Protoconch of* Cerithiopsis barleei Jeffreys, 1867.

Odostomia scillae var. *compactilis* Jeffreys, 1867. *Brit. Conch.*, 4: 169.
Eulimella commutata Monterosato, 1884. *Nomec. Generica*: 98.

Material examinado: 15 e, 80 c.

Después del estudio de más de 200 conchas procedentes del Mediterráneo, Golfo de Vizcaya, África Occidental (Mauritania) e Islas Canarias pertenecientes a este grupo, mantenemos la opinión ya expresada en Peñas y Rolán (1997) y dudamos de que existan dos especies diferentes, según defienden Nofroni y Tringali (1995). Ciertamente existen dos formas extremas en cuanto al diámetro y altura de la protoconcha y diámetro de las primeras vueltas de la teloconcha. La figura 28 correspondería a *E. subcylindrata*, con un diámetro de protoconcha de 235 μm y una altura de 125 μm, y con microescultura espiral en la teloconcha; y la figura 27 correspondería a *E. acicula*, con un diámetro de protoconcha de 255 μm y una altura de 160 μm, sin microescultura espiral. Ambas formas extremas proceden del mismo fondo aquí estudiado. No obstante, en este fondo y también en otros estudiados se encuentran formas y diámetro de protoconchas intermedios, ejemplares de ambos taxones con y sin microescultura espiral; además, ambas formas conviven en todas las profundidades estudiadas y no se ha podido constatar que una de ellas sea típica de una determinada bicenosis o de una determinada profundidad.

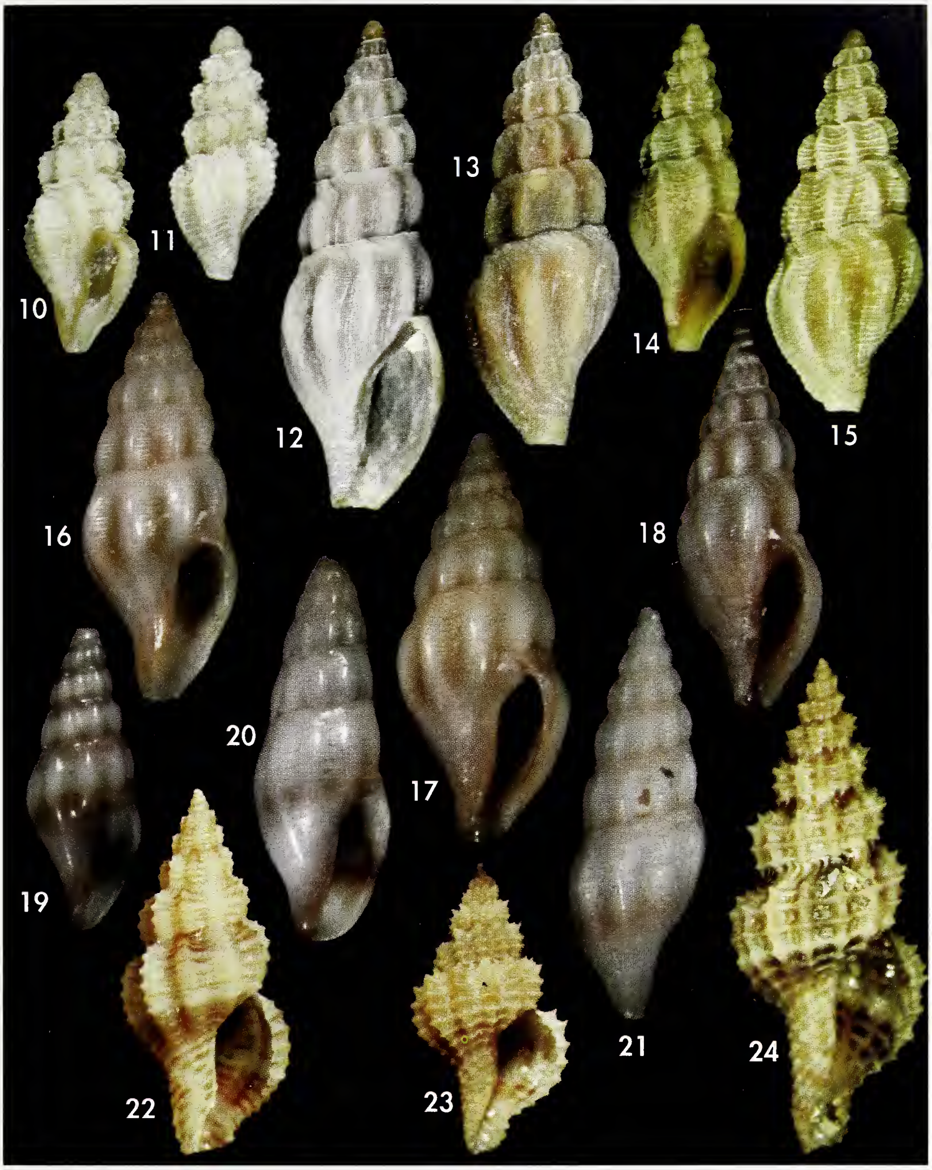
Turbonilla rufa (Philippi, 1836) (Figs. 29-32)

Melania rufa Philippi, 1836. *Enum. Moll. Sic.*, 1: 156, lám. 9, fig. 7 [Localidad tipo: Magnisi, Sicilia].
Chemnitzia densecostata Philippi, 1844. *Moll. Sic.* II: 132, lám. 24, fig. 9.
Odostomia formosa Jeffreys, 1848. *Ann. Mag. Nat. Hist.*, 2 (2): 347, lám. 26, fig. 10.

Material examinado: 280 e, 140 c.

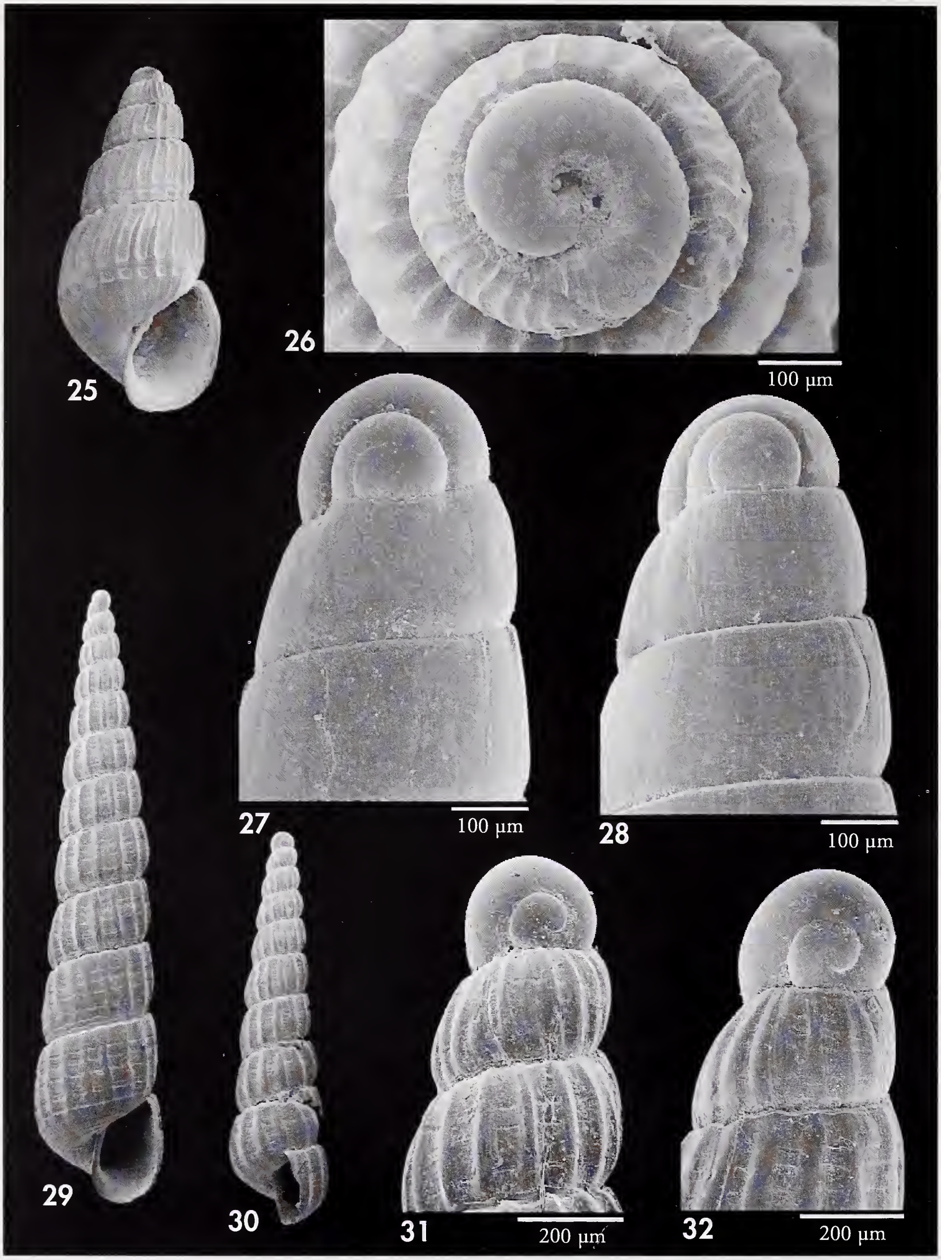
Solustri y Micali (2004) siempre encontraron esta especie en fondos arenosos (entre el 80% y 100% de arena), y la consideran típica de esos fondos; sin embargo, los más de 400 ejemplares obtenidos, la mayoría vivos, en la zona de estudio, que es un fondo detrítico fangoso, no arenoso, nos inclina a pensar que la causa de tal abundancia se debe a la mayor o menor presencia de la especie o especies a las que parasita. Desconocemos con exactitud a qué especies parasita; probablemente el serpúlido *Ditrupa*.

Todos los ejemplares obtenidos en esta biocenosis pertenecen a una de las dos formas que se encuentran en el Mediterráneo: concha unicolor, castaño oscuro en ejemplares vivos o frescos, estrecha, protoconcha con un diámetro de unas 255-260 μm. Philippi (1836) ilustra una concha monocolor y creemos que nuestros ejemplares pertenecen a esa forma. La concha ilustrada en Peñas y Rolán (1997), procedente del Atlántico sahariano pertenece a la forma más ancha, bicolor, con un diámetro de protoconcha de 300-310 μm. La protoconcha (Fig. 32) procedente de Mijas, Málaga, pertenece a este segundo grupo y también pertenece a esta forma la ilustrada en Fretter, Graham y Andrews (1986), como *T. crenata* (Brown, 1827). No hemos examinado el material tipo de ninguna de ellas y, en consecuencia, no podemos afirmar categóricamente qué taxones son válidos y cuales sinónimos, pero después del estudio de gran cantidad de conchas del Mediterráneo y Atlántico oriental, incluidas las procedentes de las colecciones del MNCN y del BMNH, nos inclinamos por la existencia de dos especies válidas: *T. rufa* y *T. crenata*.



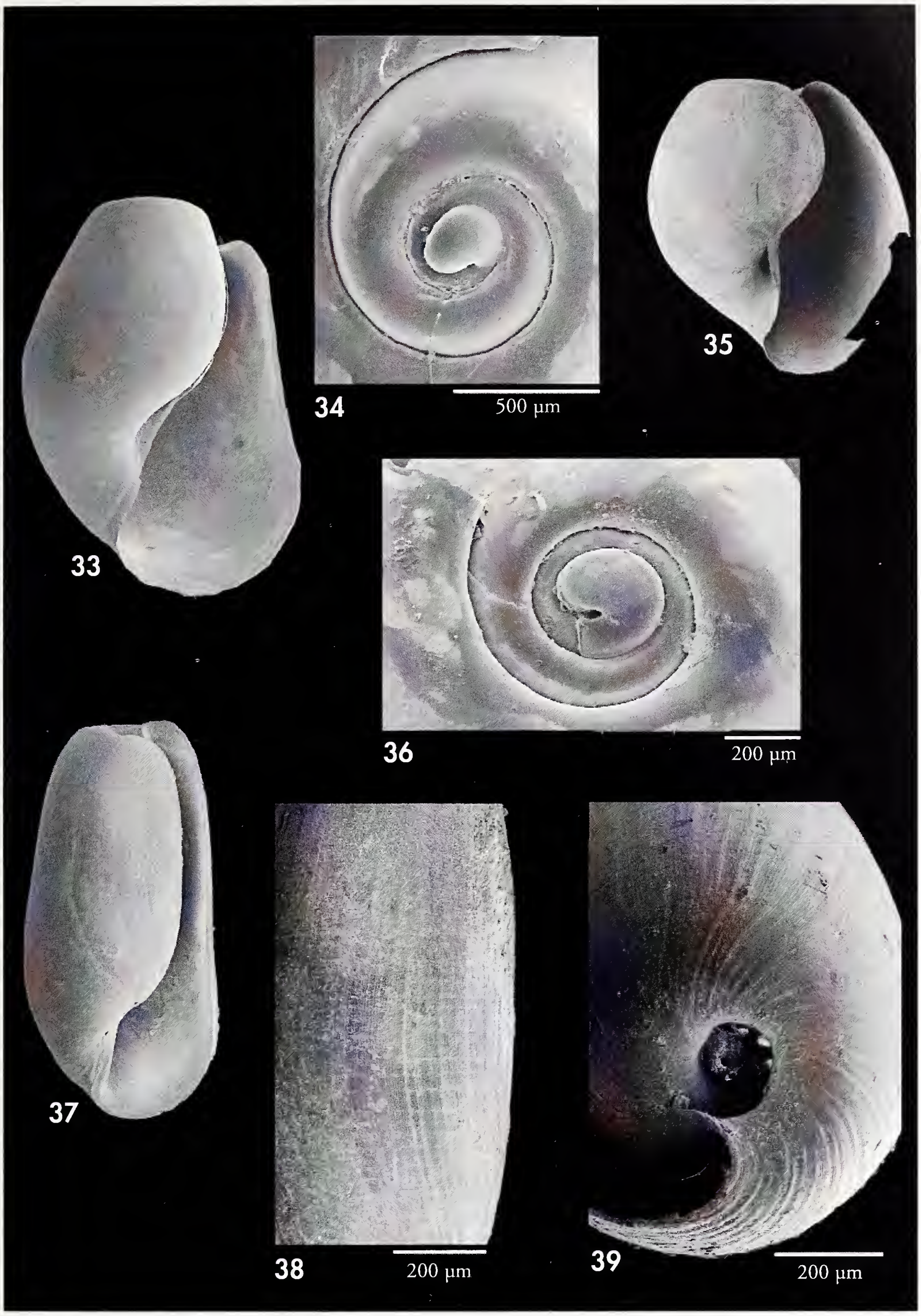
Figuras 10, 11. *Bela brachystoma* (Philippi, 1844), 4,3 y 4,0 mm. Figuras 12, 13. *Bela fuscata* (Deshayes, 1835), 9,0 y 10,2 mm. Figuras 14, 15. *Bela nebula* (Montagu, 1803), 6,7 y 7,7 mm. Figuras 16-18. *Bela ornata* (Locard, 1897), 7,4, 7,6 y 6,5 mm, sintipos (MNHN). Figuras 19-21. *Bela zonata* (Locard, 1892), 4,3, 6,4, 7,5 mm, sintipos (MNHN). Figura 22. *Raphitoma aequalis* Jeffreys, 1867, 4,2 mm. Figura 23. *Raphitoma cordieri* (Payraudeau, 1826), 7,1 mm. Figura 24. *Raphitoma echinata* (Brocchi, 1814), 9,6 mm.

Figures 10, 11. Bela brachystoma *(Philippi, 1844), 4.3 and 4.0 mm. Figures 12, 13.* Bela fuscata *(Deshayes, 1835), 9.0 and 10.2 mm. Figures 14, 15.* Bela nebula *(Montagu, 1803), 6.7 and 7.7 mm. Figures 16-18.* Bela ornata *(Locard, 1897), 7.4, 7.6 and 6.5 mm, syntypes (MNHN). Figures 19-21.* Bela zonata *(Locard, 1892), 4.3, 6.4 and 7.5 mm, syntypes (MNHN). Figure 22.* Raphitoma aequalis *Jeffreys, 1867, 4.2 mm. Figure 23.* Raphitoma cordieri *(Payraudeau, 1826), 7.1 mm. Figure 24.* Raphitoma echinata *(Brocchi, 1814), 9.6 mm.*



Figuras 25, 26. *Chrysallida multicostata* (Jeffreys, 1884). 25: concha, 2 mm; 26: protoconcha. Figuras 27, 28. Protoconchas de *Eulimella acicula* (Philippi, 1836). 27: forma *subcylindrica*; 28: forma *acicula*. Figuras 29-32. *Turbonilla rufa* (Philippi, 1836). 29, 30: conchas de 7,3 y 4,5 mm, Vilassar; 31: protoconcha de un ejemplar de Vilassar; 32: protoconcha de un ejemplar de Mijas Costa (Málaga).

Figures 25, 26. Chrysallida multicostata *(Jeffreys, 1884), 25: shell, 2 mm; 26: protoconch. Figures 27, 28. Protoconcha of* Eulimella acicula *(Philippi, 1836). 27:* subcylindrica *morph; 28:* acicula *morph. Figures 29-32.* Turbonilla rufa *(Philippi, 1836). 29, 30: shells 7.3 and 4.5 mm, Vilassar; 31: protoconch of a specimen from Vilassar; 32: protoconch of a specimen from Mijas Costa (Málaga).*



Figuras 33, 34. *Diaphana minuta* Brown, 1827. 33: concha, 4,5 mm; 34: protoconcha. Figuras 35, 36. *Diaphana* cf. *cretica* (Forbes, 1844). 35: concha, 2,5 mm; 36: protoconcha. Figuras 37-39. *Cylichnina umbilicata* (Montagu, 1803). 37: concha, 2,1 mm; 38: microescultura; 39: ápice.
Figures 33, 34. Diaphana minuta *Brown, 1827. 33: shell, 4.5 mm; 34: protoconch. Figures 35, 36.* Diaphana *cf.* cretica *(Forbes, 1844). 35: shell, 2.5 mm; 36: protoconch. Figures 37-39.* Cylichnina umbilicata *(Montagu, 1803). 37: shell, 2.1 mm; 38: microsculpture; 39: apex.*

Diaphana minuta Brown, 1827 (Figs. 33, 34)

Diaphana minuta Brown, 1827. *Illust. Conch. Gr. Brit. And Ir.*, 1: lám. 38, figs. 7-8. [Localidad tipo: Loch Torridon, Escocia, Gran Bretaña].
Amphisphyra expansa Jeffreys, 1865. *Rep. Brit. Ass. Advanc. Sci.*, 1864: 330-332.

Material examinado: 3 c.

Esta especie, redescrita por Schiøtte (1998), tiene una forma pentagonal, lisa, salvo las líneas de crecimiento, espira acuminada o ligeramente cóncava, la última vuelta ovalada de perfil; protoconcha planctotrófica de unas 1.5 vueltas, con un diámetro de unas 300 µm y un ángulo de 135º respecto al eje de la teloconcha.

Diaphana cf. *cretica* (Forbes, 1844) (Figs. 35, 36)

Bulla cretica Forbes, 1844. *Rep. Brit. Ass. Advanc. Sci.*, 1843: 188. [Localidad tipo: Creta, 218 m].

Material examinado: 1 c.

A primera vista la concha de esta especie parece más bien pertenecer a *Diaphana globosa* (Lovén, 1846), citada para el Atlántico norte europeo, por el perfil globoso de la concha y espira más claramente cóncava, mientras que *D. cretica*, especie mediterránea, tiene un hombro más anguloso y la espira más bien acuminada, con la protoconcha emergida; sin embargo la primera tiene una protoconcha mucho mayor, con un diámetro mayor de 450 µm y unas 2 vueltas de media, mientras que *D. cretica* tiene una protoconcha menor de 370 µm y 1,7 vueltas, según Schiøtte (1998). Nuestro ejemplar mide 2.5 x 2.2 mm y la protoconcha tiene un diámetro de 320 µm con 1.3 vueltas, lo que nos inclina a considerar nuestra especie más cercana a *D. cretica*. Se cita aquí por primera vez para el Mediterráneo español.

Johania retifera (Forbes, 1844) (Figs. 40-43)

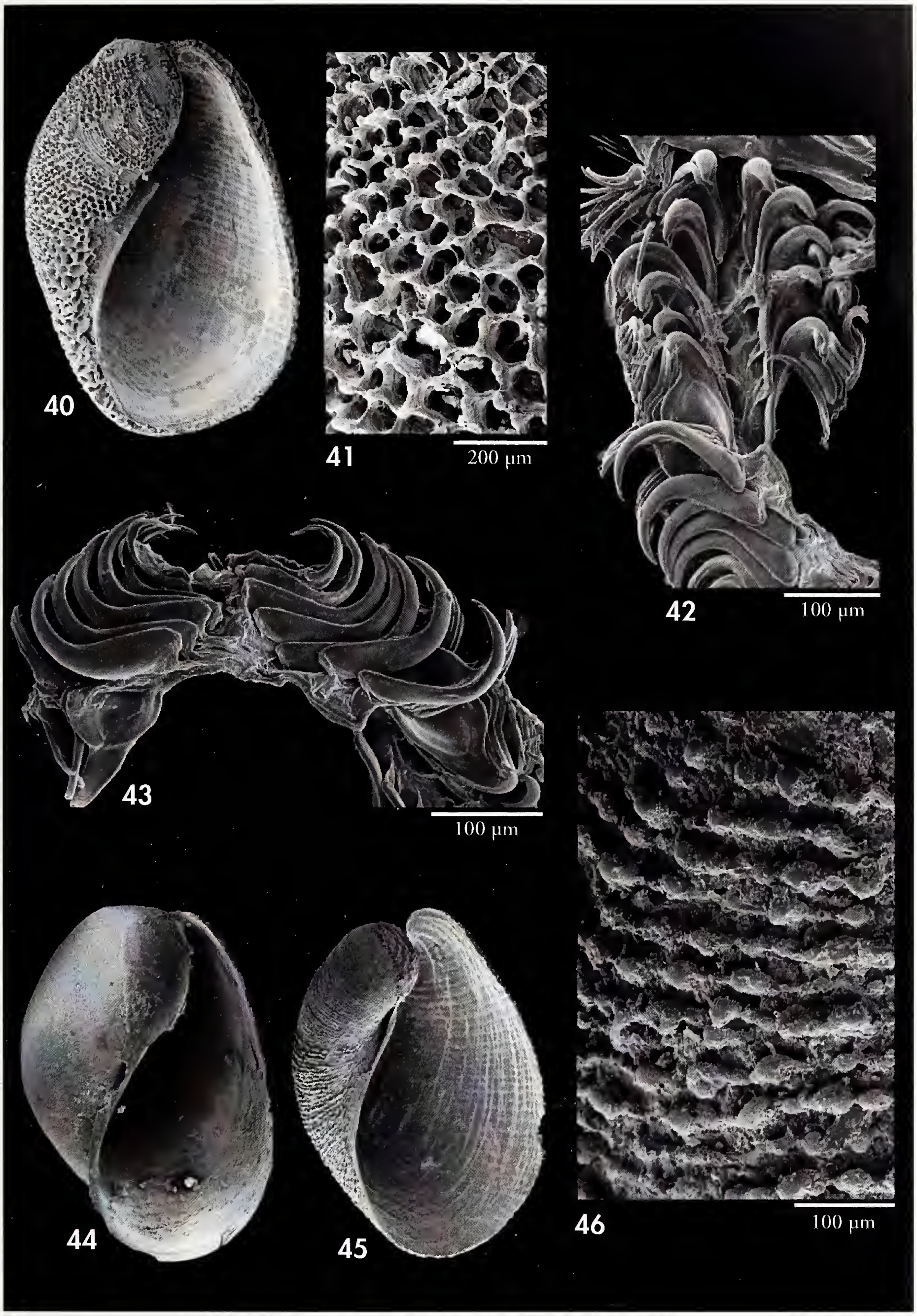
Bulla retifera Forbes, 1844. *Rept. Brit. Ass. Adv. Sci.* (1843), 13: 187. [Localidad tipo: Seripho, Mar Egeo].
Bulla vestita Philippi, 1844. *Enum. Mollusc. Siciliae,* vol 2: 95, lám. 20, fig. 4.

Material examinado: 3 e, 5 c.

Esta rara especie fue fotografiada por primera vez por Piani y Turolla (1980), apenas citada anteriormente, quienes también discuten la sinonimia con *J. vestita.* La concha (Fig. 40) es oval, frágil, de color crema a castaño claro en ejemplares vivos o frescos, blanquecino en conchas muertas. La microescultura (Fig. 41) está formada por un complejo entramado con múltiples huecos comunicados entre sí, y salientes en forma de nódulos elevados en los cruces. La rádula (Figs. 42, 43) se deshace fácilmente y parece estar formada por dientes marginales con una base ancha, cóncava, de la que parte una zona prominente que se curva a su extremo.

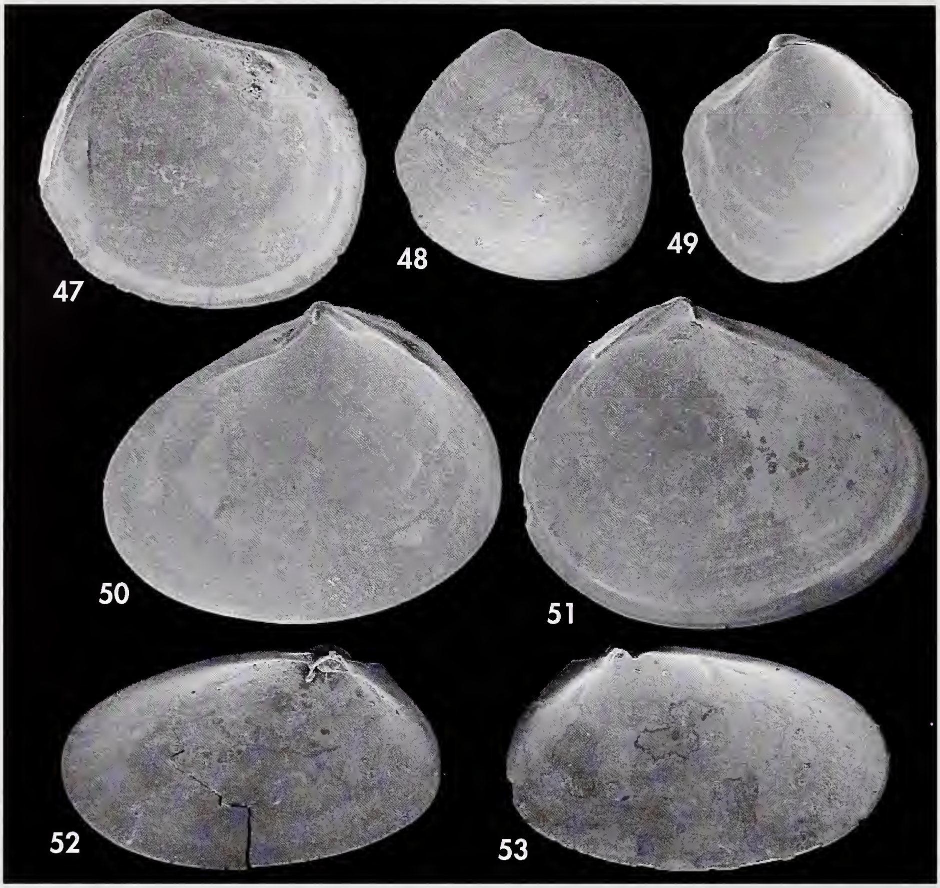
Malaquias (2004, fig. 3-D) ilustra el lectotipo de *Philine trachyostraca* Watson, 1897, cuya escultura no presenta diferencias con la de *J. retifera,* aunque en la forma de la concha de esa especie parece más cercana a *L. pruinosa.*

Se cita aquí por primera vez para el Mediterráneo español y por primera vez se fotografía la rádula.



Figuras 40-43. *Johania retifera* (Forbes, 1844). 40: concha, 4,3 mm: 41: microescultura; 42, 43: rádula. Figura 44. *Laona flexuosa* (M. Sars, 1870), concha, 4,4 mm. Figuras 45, 46. *Laona pruinosa* (W. Clark, 1827). 45: concha, 3,5 mm; 46: detalle de la microescultura.

Figures 40-43. Johania retifera *(Forbes, 1844). 40: shell, 4.3 mm: 41: microsculpture; 42, 43: radula. Figure 44.* Laona flexuosa *(M. Sars, 1870), shell, 4.4 mm. Figures 45, 46.* Laona pruinosa *(W. Clark, 1827). 45: shell, 3.5 mm; 46: detail of the microsculpture.*



Figuras 47-49. *Thyasira alleni* Carroza, 1981, valvas, 2,3, 1,8 y 1,7 mm. Figuras 50, 51. *Litigiella glabra* (P. Fischer in de Folin y Périer, 1873), valvas del mismo ejemplar, 2,9 mm. Figuras 52, 53. *Montacuta ferruginosa* (Montagu, 1808), valvas del mismo ejemplar, 2,5 mm.
Figures 47-49. Thyasira alleni *Carroza, 1981, valves, 2.3, 1.8 and 1.7 mm. Figures 50, 51.* Litigiella glabra *(P. Fischer in de Folin and Périer, 1873), valves of the same specimen, 2,9 mm. Figures 52, 53.* Montacuta ferruginosa *(Montagu, 1808), valves of the same specimen, 2.5 mm.*

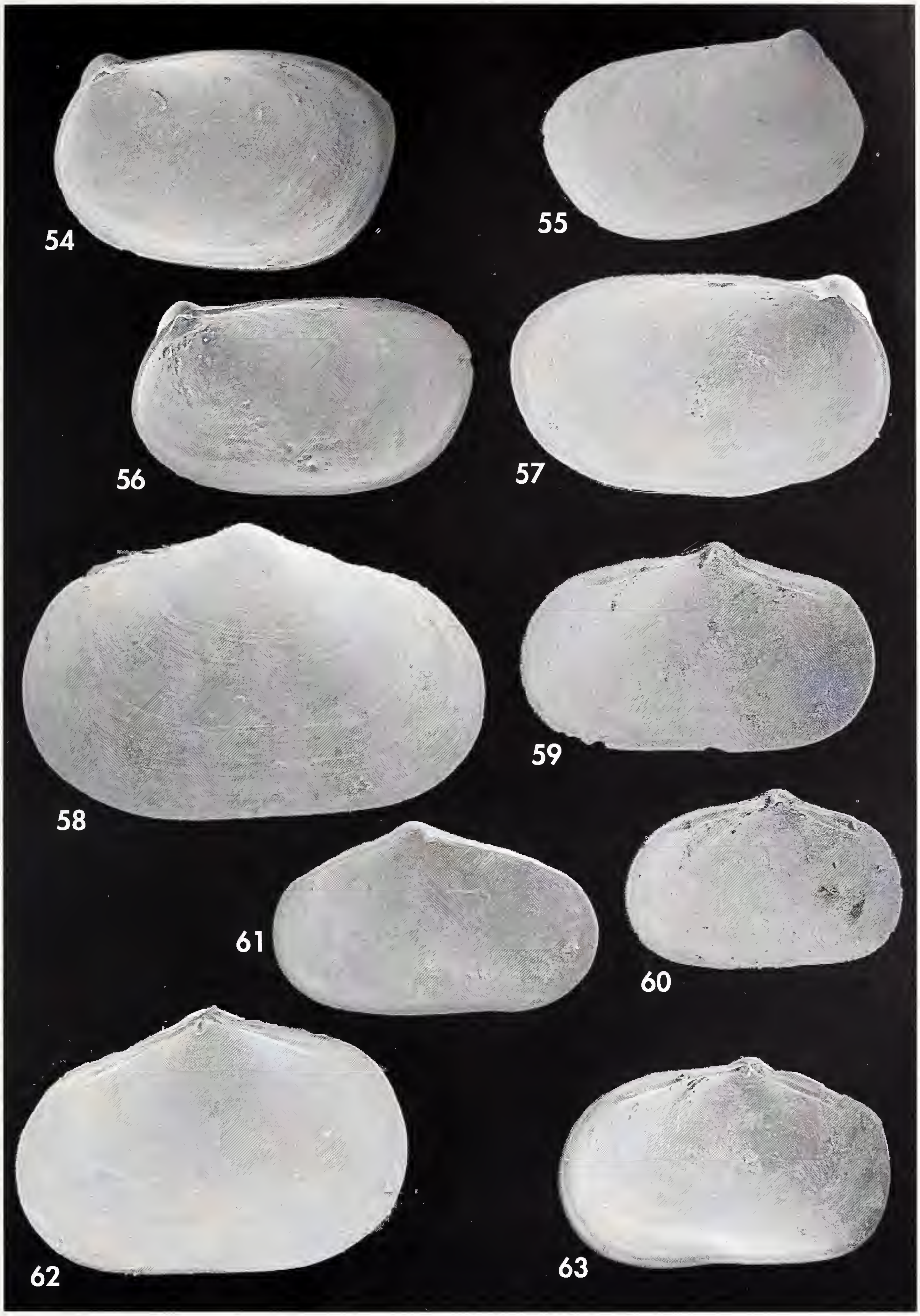
Laona flexuosa (M. Sars, 1870) (Fig. 44)

Philine flexuosa M. Sars, 1870. *Nyt Mag. Naturvid.*, 17: 113.
Philine membranacea Monterosato, 1880. *Bull. Soc. Malac. Italiana*, 6: 78 (*nomen nudum*).

Material examinado: 1 e, 1 c.

Concha (Fig. 44) oval-globosa, muy frágil, blanca, sin escultura salvo las líneas de crecimiento, espira cóncava, la última vuelta cubre las anteriores, labro interior ligeramente incurvado hacia el exterior, ombligo estrecho. GAGLINI (1991) ilustra una concha de la colección de Monterosato con la etiqueta *Philine membranacea*, la cual tiene un perfil más globoso que las aquí ilustradas, pero sin otras diferencias apreciables.

La presente es la primera cita para el Mediterráneo español.



Figuras 54-57. *Montacuta goudi* van Aartsen, 1996, valvas, 2,3, 2,1, 2,2 y 2,5 mm. 54, 55: visión exterior; 56, 57: vision interior. Figuras 58-63. *Mioerycina phascolionis* (Dautzenberg y Fischer, 1925), valvas, 3,2, 2,3, 1,7, 2,5, 2,7 y 1,9 mm.

Figures 54-57. Montacuta goudi *van Aartsen, 1996, valves, 2.3, 2.1, 2.2 and 2.5 mm. 54, 55: outer view; 56, 57: inner view. Figures 58-63.* Mioerycina phascolionis *(Dautzenberg and Fischer, 1925), valves, 3.2, 2.3, 1.7, 2.5, 2.7 and 1.9 mm.*

Laona pruinosa (W. Clark, 1827) (Figs. 45, 46)

Bullaea pruinosa W. Clark, 1827. *Zool. Journ.*, 3 (11): 339-340 [Localidad tipo: Budley Salterton, Devon, Inglaterra].
Philine granulosa M. Sars, 1869. *Förhandl. Vindesk. Krist.*, 246-275.

Material examinado: 2 e, 4 c.

Concha (Fig. 45) oval, frágil, color crema, no transparente. La superficie (Fig. 46) está formada por cordoncillos espirales irregulares, muy rugosos, fácilmente desprendibles, y en ese caso la superficie forma una fina retícula.

Las únicas citas anteriores para el Mediterráneo español son las de GIRIBET Y PEÑAS (1997) para la comarca del Garraf, Barcelona y la cita de OLIVER BALDOVÍ (2007) para Cullera, Valencia.

Litigiella glabra (P. Fischer, 1873) (Figs. 50, 51)

Lepton glabrum P. Fischer, 1873. *Les fonds de la mer* (1873), 2: 83-84, lám. 2, fig. 9. [Localidad tipo: Laredo, norte de España].
Erycina cuenoti Lamy, 1908. *Jour. Conchyl.*, 56: 35-37, figs. 1-4..
Montacuta perezi Pelseneer, 1906. *Bull. Acad. Roy. Belg.*, 12: 1146-1147.

Material examinado: 1 e + 2 v.

Se caracteriza por tener dos pequeños dientes cardinales en la valva izquierda y uno en la valva derecha y tener diente lateral en ambas valvas. HOEKSEMA, VAN AARTSEN, KEUKELAAR-VAN DER BERGE, VAN NIEULANDE Y SIMONS (1995) redescriben esta especie, citándola por primera vez para aguas españolas en el Atlántico (Huelva), Cantábrico (Laredo) y Mediterráneo (San Carlos de la Rápita y Calpe). BOGI, COPPINI Y MARGELLI (1992) la citan para aguas de Italia, y resaltan el perfil sinuoso del borde de ambas valvas en la zona ventral y umbonal. Aquí se cita por segunda vez para el Mediterráneo español.

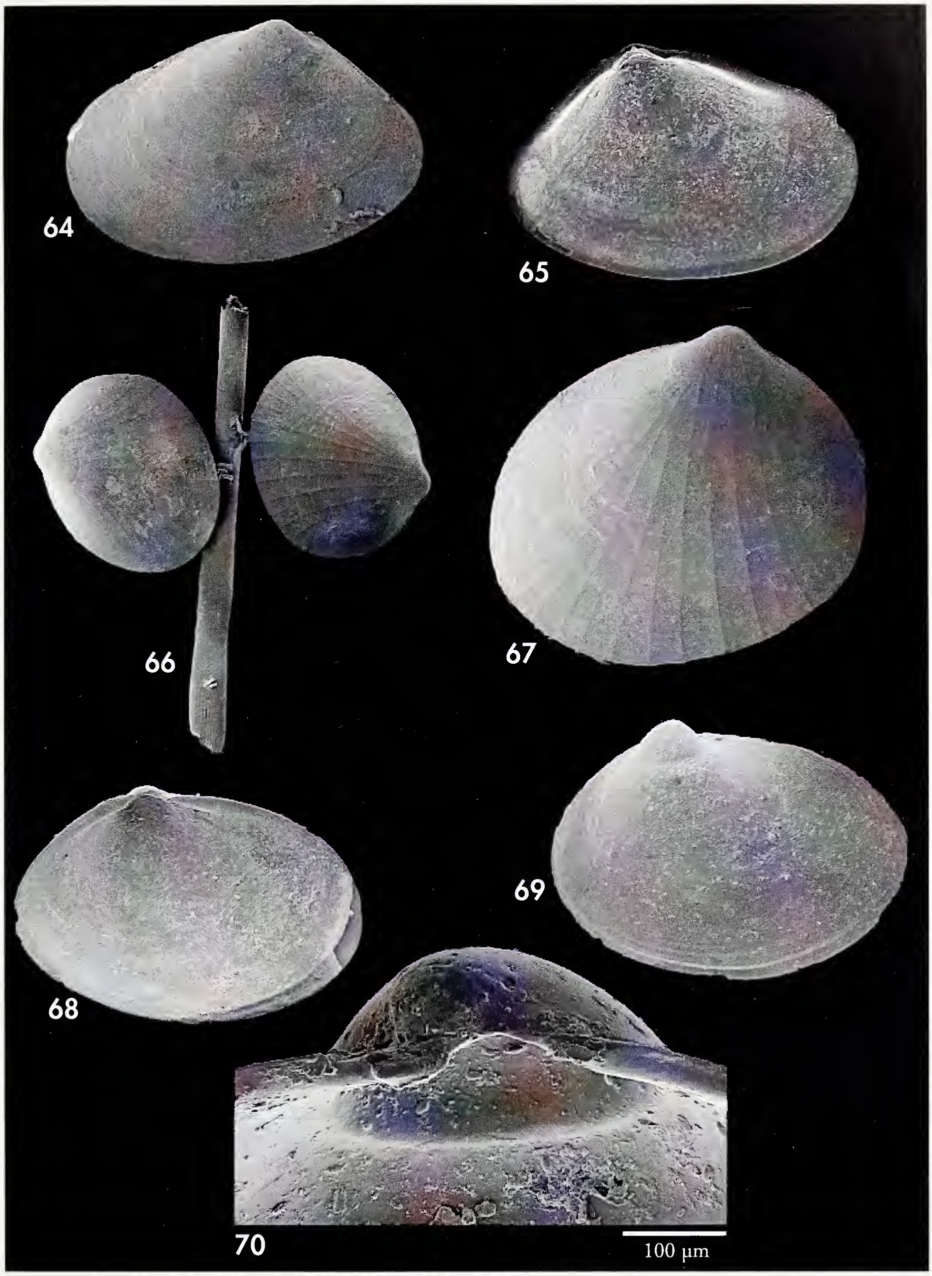
Montacuta ferruginosa (Montagu, 1808) (Figs. 52, 53)

Mya ferruginosa Montagu, 1808. *Test. Brit.*, 2 suppl.: 22, 166, lám. 26, fig. 2.
Tellimya oblonga Turton, 1822. *A survey and illust. catalogue... (Moll. Bival.)*
Erycina onodon Philippi, 1836. *Enum. Mollusc. Siciliae.*
Thracia elongata Philippi, 1844. *Abbild. Und Bresch.*

Material examinado: 5 v.

Concha (Figs. 52, 53) de perfil elíptico, frágil, color blanco, periostraco delgado amarillento, con depósitos ferruginosos, resultado de las secreciones de los erizos con los que vive de comensal; sin diente cardinal, dientes laterales poco desarrollados, umbo situado en la mitad posterior; la especie se identifica facilmente por la zona cóncava en el borde anterior junto al umbo, determinando una especie de diente. Especie típica de fondos detrítico fangosos vive preferentemente comensal con *Echinocardium cordatum* y *Spatangus purpureus.*

Montacuta goudi van Aartsen, 1996 (Figs. 54-57)



Figuras 64, 65. *Montacuta semirubra* Gaglini, 1992, valvas, 4,2 y 4,2 mm. Figuras 66, 67. *Montacuta substriata* (Montagu, 1808). 66: dos conchas (ambas de 1,5 mm) adheridas a una espícula de erizo; 67: detalle de una de ellas. Figuras 68-70. *Montacuta tenella* Lovén, 1846. 68, 69: valvas del mismo ejemplar, 1,8 mm. 70: prodisoconcha.

Figures 64, 65. Montacuta semirubra *Gaglini, 1992, valves, 4.2 and 4.2 mm. Figures 66, 67.* Montacuta substriata *(Montagu, 1808). 66: two shells (both 1.5 mm) attached to an urchin spine; 67: detail of one of them. Figures 68-70.* Montacuta tenella *Lovén, 1846. 68, 69: valves of the same specimen, 1.8 mm. 70: prodissoconch.*

Montacuta goudi van Aartsen, 1996. *La Conchiglia*, 28 (281): 27, figs. 1L, 1R, 2L, 2R. [Localidad tipo: Punta Umbría, Huelva, España].

Material examinado: 5 e + 40 v.

Especie muy frágil, semitransparente, muy inequilateral, valvas algo inchadas, con la charnela poco evidente, sin diente cardinal. Descrita para aguas atlánticas del sur de España (Punta Umbría, Huelva) y de Canarias, fue citada por primera vez para el Mediterráneo en Malta por CACHIA, MIFSUD Y SAMMUT (2004). MARGELI *ET AL.* (2006) la citan para Italia. RUEDA, SALAS Y GOFAS (2000) la citan para la bahía de Barbate, cerca del Estrecho de Gibraltar y BORJA Y MIXIKA (2001) para el Golfo de Vizcaya. Aquí se cita por primera vez para el Mediterráneo español, siendo común en el tipo de fondo estudiado.

Montacuta semirubra Gaglini, 1992 (Figs. 64, 65)

Montacuta semirubra Gaglini, 1992. *Argonauta*, 7, 1-6 (37): 178, figs. 165, 166. [Localidad tipo: Palermo].
Montacuta semirubra Monterosato, 1872 (nomen nudum).
Montacuta cuneata Gaglini, 1992. *Argonauta*, 7, 1-6 (37): 178, figs. 163, 164.

Material examinado: 4 v.

Esta rara especie mediterránea fue citada por MONTEROSATO (1872) pero no descrita; vive asociada a *Spatangus purpureus*. GAGLINI (1992) la describe cohabitando con *Montacuta substriata*. Se citó por primera vez para aguas españolas por PEÑAS Y GIRIBET (2003) en la comarca del Garraf (Barcelona), a una profundidad de 105 m. Se cita aquí por segunda vez para el Mediterráneo español. BOGI Y VAN AARTSEN (2006) la citan para varias localidades del Mediterráneo Central y Oriental hasta una profundidad de 400 m y defienden que esta especie debería ubicarse en el género *Tellimya*, tras el estudio de la charnela.

Montacuta substriata (Montagu, 1808) (Figs. 66, 67)

Ligula substriata Montagu, 1808. *Test. Brit.*, 2, suppl. 25.

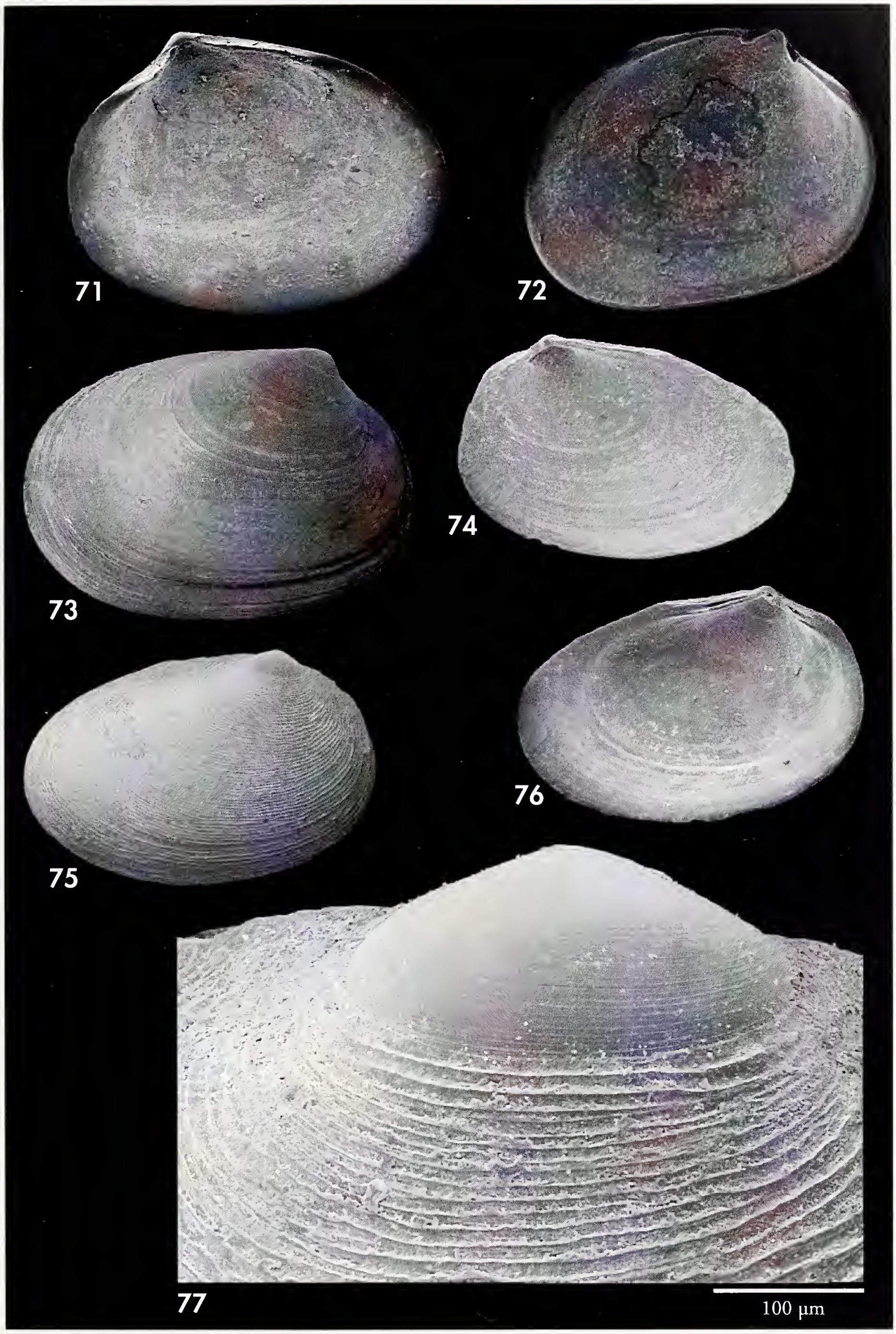
Material examinado: 25 e + 110 v.

Esta especie, caracterizada por sus costillas radiales, tiene un periostraco delgado de color castaño, muy brillante; carece de diente cardinal y no tiene claramente desarrollado el diente lateral posterior. Común en el área de estudio, ha sido recolectada cogida por el biso a las espinas de *Spatangus purpureus* (Fig. 66), erizo común en estos fondos. TEBBLE (1976) la cita asociada también a *Echinocardium flavescens* (O. F. Müller, 1776).

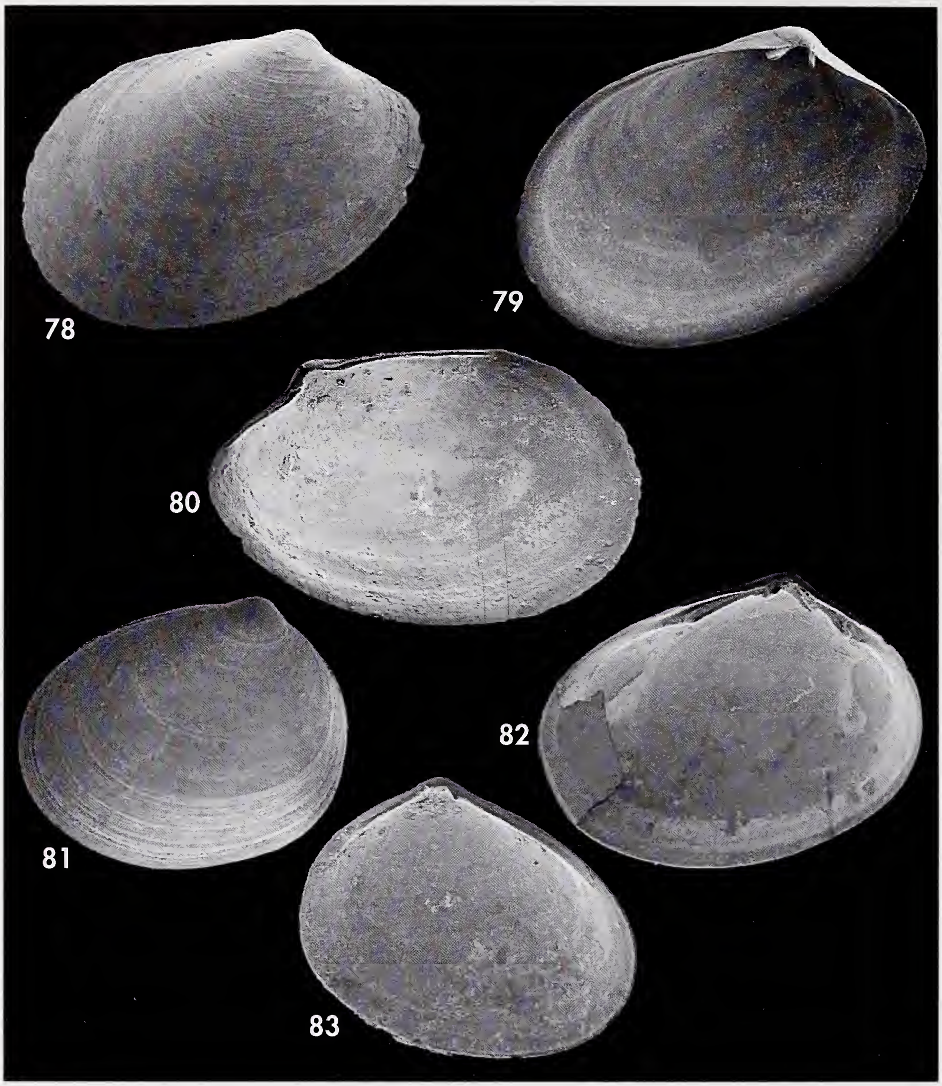
Montacuta tenella Lovén 1846 (Figs. 68-70)

Montacuta tenella Lovén, 1846. *Index. Moll. Scand.*: 43.
Decipula ovata Friele, 1876. *Forh Viden. Selsk. Krist.* (1875): 57.
Tellimya ovalis G. O. Sars, 1878. *Moll. Reg. Arct. Norv.*: 341, lám. 34, figs. 1a-c.

Material examinado: 3 v.

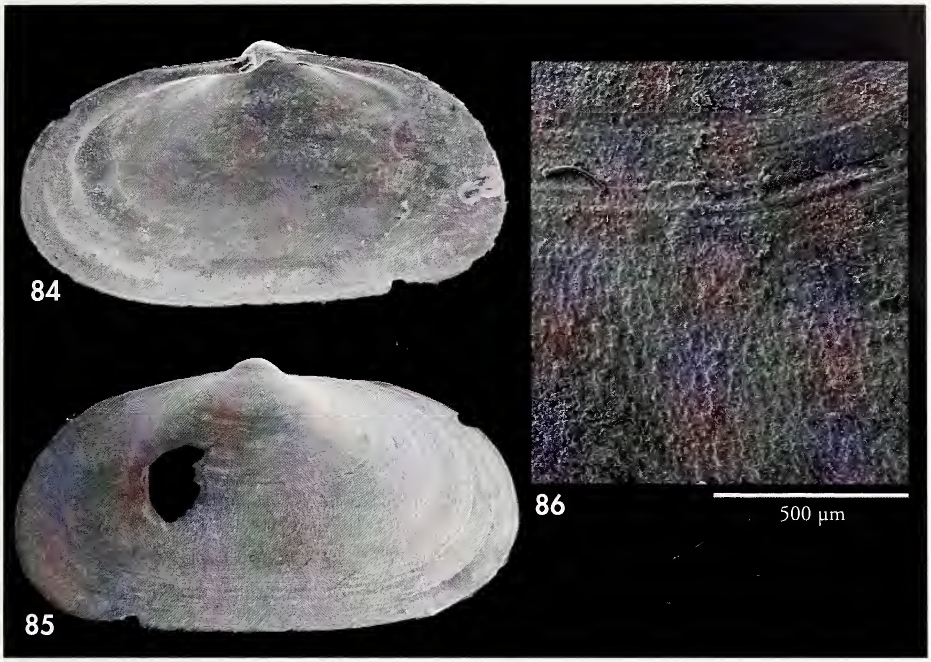


Figuras 71-73. *Kurtiella bidentata* (Montagu, 1803), valvas, 2,7, 2,4 y 2,5 mm. Figuras 74-77. *Coracuta obliquata* (Chaster, 1897). 75, 76: valvas, 1,9, 1,9 y 1,9 mm; 77: prodisoconcha.
Figures 71-73. Kurtiella bidentata *(Montagu, 1803), valves, 2.7, 2.4 and 2.5 mm. Figures 74-77.* Coracuta obliquata *(Chaster, 1897). 75, 76: valves, 1.9, 1.9 and 1.9 mm; 77: prodissoconch.*



Figuras 78-80. *Kurtiella tumidula* (Jeffreys, 1866). Valvas, 2,4, 2,4 y 2,5 mm. Figuras 81-83. *Epilepton clarkiae* (W. Clark, 1852), valvas, 1,6, 2,4 y 1,6 mm.
Figures 78-80. Kurtiella tumidula *(Jeffreys, 1866). Valves, 2.4, 2.4 and 2.5 mm. Figures 81-83.* Epilepton clarkiae *(W. Clark, 1852), valves, 1.6, 2.4 and 1.6 mm.*

Especie muy frágil, subelíptica, con una charnela poco desarrollada, sin diente cardinal. KALLONAS, ZENETOS Y GOFAS (1999) la citan por primera vez para el Mediterráneo, en Grecia, viviendo asociada al equinodermo *Brissopsis lyrifera* (Forbes, 1841). Las citas posteriores en el Mediterráneo son escasas: una valva izquierda en sedimento de una gruta en Taormina, Sicilia (PALAZZI Y VILLARI, 2001) y una valva derecha en el Adriático meridional (MICALI, TISSELLI Y GIUNCHI, 2006) La cita en el fondo aquí estudiado representa la primera para el Mediterráneo español, en el que se han encontrado solamente tres valvas.



Figuras 84-86. *Sportella recondita* (P. Fischer in de Folin, 1872). 84, 85: valvas, 5,3 y 5,6 mm; 86: microescultura.
Figures 84-86. Sportella recondita *(P. Fischer in de Folin, 1872). 84, 85: valves, 5.3 and 5.6 mm; 86: microsculpture.*

Kurtiella bidentata (Montagu, 1803) (Figs. 71-73)

Mya bidentata Montagu, 1803. *Test. Brit.*, 1: 44, lám. 26, fig. 5. [Localidad tipo: Salcombe, Inglaterra].
Erycina nucleata Récluz, 1844. *Rev. Zool.*, 7: 328.
Arcinella laevis Philippi, 1844. *En. Moll.*, vol. 2: 54, lám. 16, fig. 10.
Mesodesma exiguum Lovén, 1846. *Of. Kong. Vet. Ac. För.*, 196.

Material examinado: 40 e y más de 200 v.

GOFAS Y SALAS (2008) consideran que en el género *Mysella* Angas, 1877, cuya especie tipo es *Mysella anomala* Angas, 1877, no deben ser incluidas las especies del grupo de *Mya bidentata*, que viven en el Atlántico europeo y Mediterráneo, y crean el nuevo género *Kurtiella*, perteneciente a la familia Montacutidae. Este género se caracteriza por retroceder la plataforma cardinal bajo el ligamento.

Ésta es la especie más abundante entre las Galeommatacea encontrada en el fondo aquí estudiado. También la hemos encontrado común en todo tipo de fondos detríticos desde 3-4 m hasta más de 200 m de profundidad. Vive asociada a varias especies de Ophiuroidea y según KALLONAS ET AL. (1999) vive en huecos de ostras, del sipuncúlido *Golfingia* y en asociación con *Acrocnida brachiata*. Valvas frágiles, blancas, brillantes, periostraco color crema, apenas brillante; sin diente cardinal, los dientes de la valva derecha bien marcados y menos formados los de la valva izquierda.

Kurtiella tumidula (Jeffreys, 1866) (Figs. 78-80)

Montacuta tumidula Jeffreys, 1866. *Ann. Mag. Nat. Hist.*, 3 (18): 396. [Localidad tipo: Noroeste de la costa de Rosshire, Escocia].

Material examinado: 4 v.

Sin diente cardinal, dientes laterales igualmente desarrollados. ZENETOS Y VAN AARTSEN (1995) citan esta especie por primera vez en el Mediterráneo para aguas del Mar Egeo. VAN AARTSEN (1996) la cita en Palermo, Sicilia, de la colección Monterosato. Recientemente se ha citado en el Tirreno por MARGELLI, CAMPANI, COPPINI Y CUNEO (2006) y en Malta por CACHIA *ET AL.* (2004). GOFAS Y SALAS (2008) la citan para el Mar de Alborán. Se cita aquí por segunda vez para el Mediterráneo español, habiéndose encontrado dos valvas derechas y dos izquierdas.

Coracuta obliquata (Chaster, 1897) (Figs. 74-77)

Neolepton obliquatum Chaster, 1897. *The Irish Nat.*, 6: 186, figs. 1,2.

Material examinado: 2 e + 7 v.

Concha (Figs. 74-76) menos frágil, muy inequilateral, sin diente cardinal, umbo evidente situado en la mitad posterior de la valva y con una evidente escultura concéntrica (Fig. 77) en el exterior de las valvas. Esta especie la hemos encontrado desde relativamente poca profundidad, -24 m en fondo de gorgonias en Mijas, Málaga, hasta los 250/350 m en fondos de coral blanco en el Garraf, donde es común.

HOLMES, GALLICHAN Y WOOD (2006) crean el nuevo género *Coracuta*, cuya especie tipo es *Neolepton obliquatum* Chaster, 1897.

Myoerycina phascolionis (Dautzenberg y Fischer, 1925) (Figs. 58-63)

? *Galeomma compressa* Philippi, 1844: 19, pl. 14, fig. 5.
Montacuta phascolionis Dautzenberg y Fischer, 1925. *Trav. Stat. Biol. Roscoff*, 3: 126.
? *Kellia coarctata* Wood, 1851. *Mon. Grag. Moll.*, 2 (2): 123, lám. 12, figs. 10a, b.

Material examinado: 4 v.

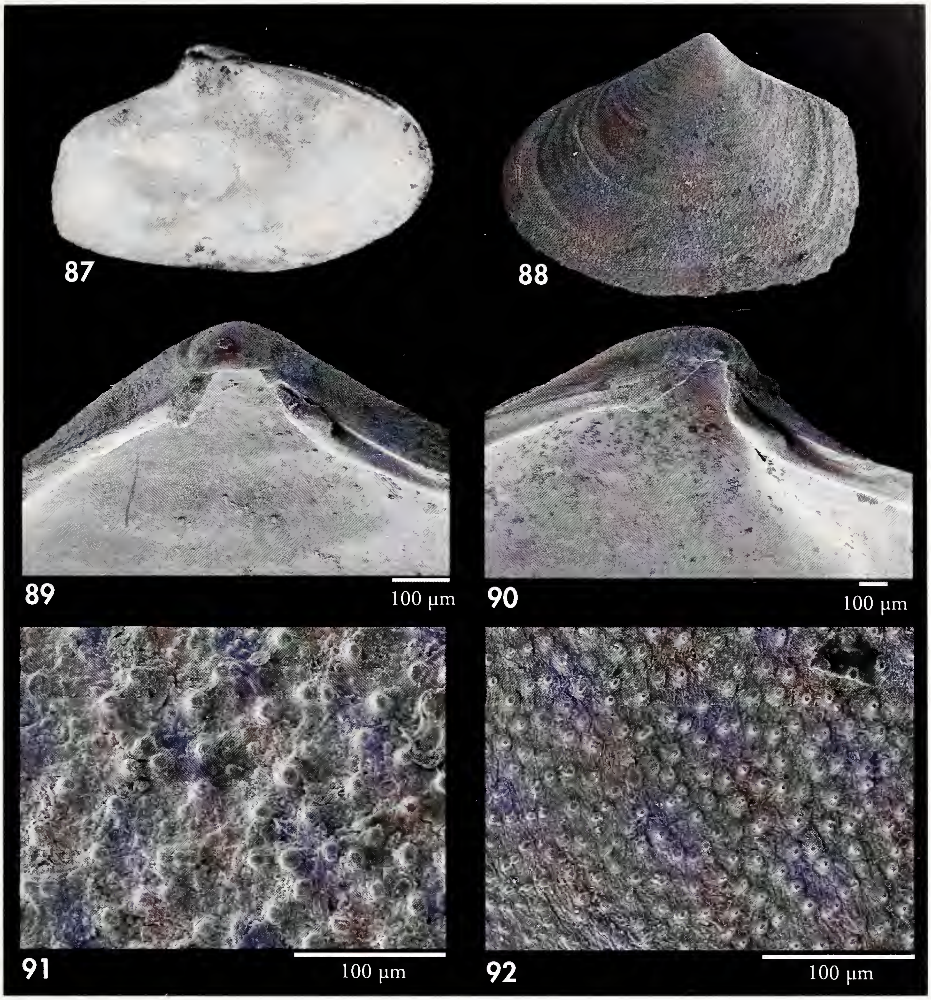
Esta especie se caracteriza por tener una pequeña plataforma cardinal y tener en la valva derecha un diente cardinal delante del ligamento y dos dientes laterales, uno anterior y otro posterior.

TRONCOSO Y URGORRI (1992) y TRONCOSO, MOREIRA Y TRONCOSO (2000) la citan en las costas gallegas asociada al sipuncúlido *Phascolion strombi* (Montagu, 1804). En el Mediterráneo español fue citada por primera vez por GIRIBET Y PEÑAS (1997) en la costa de Garraf (Barcelona). Se cita aquí por segunda vez en un fondo en el que también abunda *Phascolion strombi*, sobre todo ocupando conchas de *Turritella communis*.

Epilepton clarkiae (Clark, 1852) (Figs. 81-83)

Lepton clarkiae Clark, 1852. *Ann. Mag. Nat. Hist.*, 9 (2): 191.

Material examinado: 5 e + 14 v.



Figuras 87-92. *Thracia papyracea* (Poli, 1791). 87, 88: conchas juveniles, 15 mm y 5 mm; 89, 90: detalle de la charnela; 91, 92: microescultura, en dos zonas de la concha.
Figures 87-92. Thracia papyracea (Poli, 1791). 87, 88: juvenile shells, 15 mm and 5 mm; 89, 90: detail of the hinge; 91, 92: microsculpture, on two areas of the shell.

Concha (Figs. 81-83) frágil, de diminutas dimensiones, perfil oval oblícuo, blanca-amarillenta, muy brillante, con líneas radiales visibles a gran aumento; umbo relativamente grande, situado en la mitad posterior; charnela estrecha formada por un diente lateral anterior y otro posterior; diente cardinal en ambas valvas. La figura 82 muestra una valva excepcionalmente grande (2.4 x 1.8 mm), sólida, con los dientes laterales muy marcados.

Esta especie, al igual que *Mioerycina phascolionis*, vive asociada al sipuncúlido *Phascolion strombi*. La hemos encontrado en este fondo y también en fondos del Garraf, donde abunda *Turritella communis*, ya que ese sipuncúlido ocupa conchas vacías de ella y de otros gasterópodos.

JESPERSEN, LÜTZEN Y OLIVER (2007) revisan la posición morfológica, biológica y sistemática de esta especie.

Sportella recondita (P. Fischer in de Folin, 1872) (Figs. 84-86)

Scintella recondita P. Fischer, 1872. *Les fonds de la mer* (1876) : 49, lám. 3, fig. 3.

Material examinado: 3 v.

Concha relativamente grande (hasta 10 mm) y menos frágil. Tiene un claro diente anterior en la valva derecha y un hueco tras él en el que entran los dos dientes de la valva izquierda, de los cuales el anterior es oblícuo y el posterior vertical. CARROZZA (1981) cita esta especie para el Mediterráneo Oriental (bahía de Haifa), a una profundidad de 68 m. MARGELLI, COPPINI Y BOGI (1995) la citan para la Isla Chaparía, Italia, entre 150 y 180 m de profundidad. Aquí se cita por primera vez para el Mediterráneo español.

En PEÑAS, ROLÁN Y BALLESTEROS (2008) se cita e ilustra el hallazgo en aguas del Garraf de un ejemplar vivo de una rara especie, identificada como *Sportella* sp., cuya charnela es muy cercana a *S. recondita*, pero no la forma.

Thracia papyracea (Poli, 1791) (Figs. 87-92)

Tellina papyracea Poli, 1791. *Test. Utr. Sic.*, 1: 43, lám. 15, figs., 14, 18 non *Tellina papyracea* Gmelin, 1791.
Mya declivis Pennant, 1812. *Brit. Zool.*
Amphidesma phaseolina Lamarck, 1818. *Anim. sans Vert.* Vol. 5.
Thracia mitella De Gregorio, 1884.

Material examinado: 3 e, 6 v.

Concha frágil y delgada, blanca, no brillante, periostraco delgado castaño claro, normalmente solo en los bordes de las valvas; inequivalva, algo más convexas la valva derecha; margen anterior redondeado, margen posterior truncado; escultura de líneas concéntricas irregulares, a gran aumento superficie granulosa, áspera al tacto. Se ilustran dos conchas juveniles (Figs. 87, 88), detalle de la charnela (Figs. 89, 90) y microescultura de dos zonas de la concha (Figs. 91, 92).

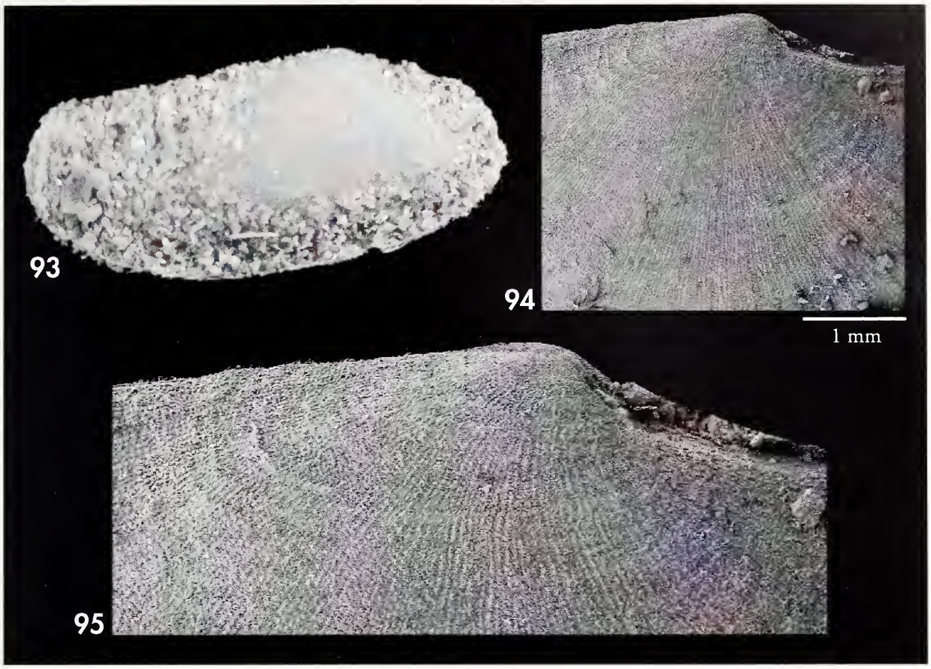
En PEÑAS, ROLÁN, LUQUE, TEMPLADO, MORENO, RUBIO, SALAS, SIERRA Y GOFAS (2006, figs. 403-406) se ilustran conchas juveniles y microescultura de de *Thracia villosiuscula* (MacGillivray, 1827) procedente de Vilassar de Mar.

Lyonsia norwegica (Gmelin, 1791) (Figs. 93-95)

Mya norwegica Gmelin, 1791. *Syst. Nat. ed.* 13: 3222, nº 24.
Mya striata Montagu, 1811.
Amphidesma corbuloides Lamarck, 1818.
Anatina truncata Lamarck, 1818
Tellina coruscans Scacchi, 1833
Anatina elonagta Hanley, 1842.
Myatella montagui Brown, 1844

Material examinado: 35 e, 52 v.

Concha (Fig. 93) oval cuadrangular, más bien frágil, blanca, con periostraco delgado color castaño claro. Charnela sin diente. Región anterior del margen dorsal recta y ligeramente inclinada; región posterior recta o algo cóncava,



Figuras 93-95. *Lyonsia norwegica* (Gmelin, 1791). 93: ejemplar juvenil, 22 mm; 94, 95: detalle de la escultura.
Figures 93-95. Lyonsia norwegica *(Gmelin, 1791). 93: juvenile specimen, 22 mm; 94, 95: detail of the sculpture.*

más grande; margen anterior redondeado, algo abierto, margen posterior truncado, más abierto. Superficie exterior (Figs. 94, 95) de aspecto rugoso, formada por numerosas estrías radiales apretadas y muy delgadas y por líneas concétricas y por un menor número de costillas, equidistantes, sobre las estrías, poco evidentes en ejemplares juveniles. Ejemplares juveniles a menudo son inidintificables porque las valvas están cubiertas por una especie de masa formada por granos de arena y otros restos de los sedimentos en los que vive.

Características del fondo estudiado

PÉRÈS Y PICARD (1964) y también AUGIER (1982) describieron varias biocenosis de sustratos blandos en el piso circalitoral, relativamente bien diferenciadas, con unos grupos de especies características o exclusivas de cada uno de ellos. El lugar aquí estudiado se encuentra en una zona abierta, sujeta a corrientes marinas relativamente fuertes y alejada de la desembocadura de ríos que aporten de forma regular sedimentos terrígenos, aunque la orografía montañosa de la comarca, con numerosas rieras y alta pluviosidad, hace que las aportaciones de fangos sean periódicas. Esta biocenosis podría definirse básicamente como un "fondo detrítico costero" (DC), si bien este tipo de fondos son muy variables, dependiendo de la costa vecina y también de las formaciones infralitorales próximas. Este fondo también podría estar relacionado con una zona de transición hacia "fangos de fuera", dada la abundancia de especies como *Similipecten similis* (Gofas, com. pers.).

Por otra parte, si tenemos en cuenta que la especie dominante en esta biocenosis es el ascidiáceo *Ascidia conchilega* (O. F. Müller, 1776), representando al menos el 50% de la biomasa animal obtenida, puede afirmarse que se trata de una "facies" de ascidiáceos. Según Pérès y Picard (1964) las formaciones de Ascidias están relacionadas más o menos directamente con poblamientos vegetales densos de una parte y de corrientes vivas de otra parte, como ocurre en este caso.

Especies dominantes en estos fondos

Se consideran especies dominantes del fondo estudiado aquellas de las que se han encontrado numerosos ejemplares vivos en todos los muestreos realizados. Son las siguientes:

Jujubinus montagui
Bittium latreillii
Turritella communis
Pusillina inconspicua
Caecum trachea
Apporrhais pespelicani
Calyptraea chinensis
Trophon muricatus
Nassarius pygmaeus
Bela brachystoma
Bela nebula
Mangelia costulata
Mangelia unifasciata
Megastomia conoidea
Odostomia acuta
Turbonilla rufa
Cylichnina crebrisculpta
Ringicula conformis
Nucula nitidosa
Nuculana commutata
Musculus subpictus
Modiolula phaseolina
Similipecten similis
Anomia ephippium
Myrtea spinifera
Thyasira biplicata
Kurtiella bidentata
Parvicardium minimum
Spisula subtruncata
Phaxas pellucidus
Abra alba
Abra prismatica
Timoclea ovata
Gouldia minima
Dosinia lupinus
Corbula gibba
Pandora pinna
Dentalium inaequicostatum
Dischides politus

Sin embargo, aunque no dominantes, pueden considerarse típicas de estos fondos todas aquellas encontradas vivas, que se indican como comunes (+++) en el listado.

Debe resaltarse que, entre los gasterópodos, la familia Conidae, especialmente los géneros *Bela* y *Mangelia,* es la más representativa de este fondo por el número de especies encontradas y la cantidad de ejemplares de cada una de ellas. Por el contrario, son numerosas las especies de Rissoidae encontradas, pero de la mayoría sólo conchas vacías; únicamente en el caso de tres de ellas, *Pusillina inconspicua, Alvania punctura* y *Obtusella macilenta* se han encontrado ejemplares vivos. En aguas catalanas estas dos especies viven desde la zona infralitoral hasta los 350 metros de profundidad en todo tipo de fondos (Giribet y Peñas, 1997). *Pseudotorinia architae* se encontró con cierta frecuencia en todos los muestreos, pero sólo conchas, aunque en uno de ellos se encontraron 40 ejemplares vivos. La familia Pyramidellidae está bien representada en este fondo, lógicamente tratándose de animales ectoparásitos, y destaca *Turbonilla rufa* por el número de ejemplares vivos encontrados, seguida de *Megastomia conoidea.*

Entre los bivalvos, la mayoría de las especies arriba citadas como dominantes se reparten la abundancia relativa. De algunos microbivalvos, especialmente de la superfamilia Galeomatoidea, se han encontrado escasas valvas, dada su fragilidad; a pesar de lo cual creemos que la mayoría de especies son típicas de estos fondos.

Se comparan nuestros resultados, con los obtenidos en un fondo de características similares en Livorno. Cuneo, Margeli, Campani y Coppini (2006) estudiaron los gasterópodos y escafópodos y listan 71 especies encontradas vivas (66 gasterópodos y 5 escafópodos). Coinciden con nuestro listado sola-

mente 40 especies (38 gasterópodos y 2 escafópodos), constatándose que en ese fondo son muy pocas las especies abundantes: *Turritella communis, Nassarius pygmaeus, Megastomia conoidea, Ringicula conformis y Dentalium inaequicostatum*, que también en nuestro listado se citan como abundantes, y también citan *Bittium reticulatum*, especie que no hemos encontrado viva. MARGELLI *ET AL.* (2006) citan 48 especies de bivalvos para la misma biocenosis de Livorno, de ellas 35 se citan también en nuestro listado. Destacan como abundantes las siguientes especies: *Myrtea spinifera, Thryasira alleni, Mysella bidentata, Timoclea ovata y Corbula gibba.*

SOLUSTRI Y MICALI (2002) también estudian la malacofauna de un fondo similar a 51 metros de profundidad en el Adriático Medio, censando 49 especies vivas (24 gasterópodos y 25 bivalvos). Los gasterópodos dominantes eran *Trophon muricatus* y *Bela brachystoma. Turritella communis* era abundante pero no se encontraron ejemplares vivos. En cuanto a los bivalvos, las especies dominantes eran *Nucula nucleus, Myrtea spinifera, Thyasira biplicata, Parvicardium minimum* y *Phaxas pellucidus*, todas coincidentes con nuestro material, excepto *Nucula nucleus*, que en nuestro fondo es sustituida por *Nucula nitidosa.*

También hemos observado que varias especies de moluscos que aquí son dominantes no lo son en otros fondos DC vecinos, como en la comarca del Garraf.

Nuevas citas para el Mediterráneo español

Seis son las especies que se citan por primera vez para el Mediterráneo español: *Lepidochiton cimicoides, Johania retifera, Laona flexuosa, Montacuta goudi, Montacuta tenella* y *Sportella recondita.*

Relación con la cercana pradera de *Posidonia oceanica*

En total se han encontrado 117 especies no vivas en la biocenosis aquí estudiada (1 poliplacóforo, 95 gasterópodos, 20 bivalvos y 1 escafópodo). De ellas, 21 especies de gasterópodos probablemente procedan precipitadas de la cercana pradera de *Posidonia oceanica*, ya que en ella se han encontrado vivas (ver PEÑAS Y ALMERA, 2001).

Por otra parte, en el fondo aquí estudiado se han encontrado 39 especies que también se encontraron vivas en dicha pradera (20 gasterópodos y 19 bivalvos), de las cuales son comunes o abundantes en ambos hábitats: *Bittium latreillii, Vitreolina curva, Vitreolina perminima, Vitreolina philippi, Obtusella intersecta, Alvania punctura, Caecum trachea, Calyptraea chinensis, Hexaplex trunculus, Chrysallida emaciata, Odostomia unidentata, Musculus subpictus, Musculus costulatus, Anomia ephippium, Lucinella divaricata, Goodallia triangularis, Timoclea ovata y Gouldia minima.*

CONCLUSIONES

El análisis de los resultados obtenidos nos permite apreciar, en primer lugar, la riqueza malacológica de estos fondos, ya que el número de especies vivas encontradas es relativamente elevado para un área estudiada muy pequeña, teniendo en cuenta que todos los dragados se realizaron en las coordenadas citadas, con una desviación inferior a un kilómetro. En segundo lugar, se puede definir con bastante aproximación qué especies componen una comunidad de moluscos en una biocenosis de fondo fangoso detrítico costero.

En total se han encontrado 332 especies (5 poliplacóforos, 219 gasterópodos, 105 bivalvos y 3 escafópodos), de ellas 213 vivas (4 poliplacóforos, 122 gasterópodos, 85 bivalvos y 2 escafópodos). Dos especies se citan solamente a nivel genérico y seis se citan por primera vez para el Mediterráneo español.

Sin embargo, a pesar de la riqueza malacológica de la zona estudiada, los autores no son optimistas, ya que se ha apreciado un retroceso en biodiversidad y madurez en el curso de los años, pues estos fondos ya fueron estudiados por el tercero de los autores, con varios dragados en la misma zona y en el mismo período estacional entre 1982 y 1990, y

se ha podido constatar el progresivo deterioro. Algunas especies, entonces encontradas comúnmente vivas, o incluso abundantes, prácticamente han desaparecido de estos fondos, como *Mitrolumna olivoidea*, *Muricopsis aradasii*, *Heliacus subvariegatus* o *Philine aperta*. Otras especies, aunque consideradas adultas, pues mantienen el número de vueltas, han ido reduciendo el tamaño de su concha, como *Eulima glabra*, *Comarmondia gracilis*, *Mangelia unifasciata*, *Mangelia costata* y, sobre todo, *M. costulata*. Y en otros casos, de algunas especies actualmente casi solo se encuentran juveniles como *Aporrhais pespelicani*, *Nuculana pella*, *Lucinoma boreales*, *Gari fervensis* y *Lyonsia norwegica*.

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Dos nuevas especies del género *Alvania* (Caenogastropoda: Rissoidae) de las islas Baleares

Two new species of the genus *Alvania* (Caenogastropoda: Rissoidae) from the Balearic Islands (Western Mediterranean)

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RESUMEN

Se describen dos nuevas especies del género *Alvania* del mar balear en base a caracteres exclusivamente conquiológicos. Una de ellas, *A. balearica* spec. nov., es similar a *A. subcrenulata* y *A. nestaresi*, de las que se diferencia por el perfil más turriculado de su concha y por algunos caracteres de la escultura de la protoconcha y teloconcha. La segunda de las especies, *A. josefoi* spec. nov., se asemeja a *A. scabra* y a *A. sculptilis*, de las que se diferencia por su menor tamaño, coloración y en algunos caracteres de la escultura de la protoconcha y teloconcha. Ambas especies muestran poca variabilidad en sus características conquiológicas.

ABSTRACT

Two new species of the genus *Alvania* from the Balearic Sea are described based on shell characters. The shell of one of them, *A. balearica* spec. nov., resembles that of *A. subcrenulata* and *A. nestaresi*, but it differs in the more turriculate outline and in some characters of the sculpture of the protoconch and teleoconch. The second one, *A. josefoi* spec. nov., is compared to the closely related *Alvania scabra* and *A. sculptilis*. It differs in being smaller, in the colour pattern of the shell and in some characters of the sculpture of the protoconch and teleoconch. Both species are very uniform in conchological characteristics.

INTRODUCCIÓN

El género *Alvania* es dentro de los gasterópodos marinos el que presenta un mayor número de especies en el Atlántico nororiental y Mediterráneo. En la base de datos CLEMAM (septiembre de 2008) se incluyen 129 especies de este género para el área geográfica antes señalada. De éstas, algo más de la mitad están presentes en el Mediterráneo y cerca de 40 de ellas (el número puede variar en función de los criterios taxonómicos seguidos) han sido citadas en el Mediterráneo español. Esta gran diversidad de especies es consecuencia del elevado número de endemismos que presenta el género, con áreas de distribución muy reducidas. Ello es especialmente patente en los distintos conjuntos insulares. Dentro del Mediterráneo se conocen especies endémicas de este género en las islas del Tirreno, Jónico, Adriático, Egeo o Chipre (BOGI, COPPINI Y MARGELLI, 1983; OLIVERIO, 1986, 1988; GIUSTI Y NOFRONI, 1989; VAN DER

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Linden y Wagner, 1989; Cecalupo y Quadri, 1995; Margelli, 2001; Buzzurro, 2003; Micali, Tisselli y Giunchi, 2005; Buzzurro y Landini, 2007; Buzzurro y Prkic, 2007). El hecho es que se vienen describiendo nuevas especies de forma paulatina, que han salido a la luz, bien por el estudio faunístico de áreas poco estudiadas, o por la revisión de algunos grupos de *Alvania* conflictivos. Amati, Nofroni y Oliverio (1990) relacionan las nuevas especies del género descritas entre 1980 y 1990, y desde entonces se ha incrementado su número en siete más: *A. nestaresi* Oliverio y Amati, 1990, *A. clarae* Nofroni y Pizzini, 1991, *A. elisae* Margelli, 2001, *A. oliverioi* Buzzurro, 2003, *A. alboranensis* Peñas y Rolán in Peñas *et al.*, 2006, *A. claudioi* Buzzurro y Landini, 2007 y *A. dalmatica* Buzzurro y Prkic, 2007. Dos de ellas (*A. nestaresi* y *A. alboranensis*) pertenecen a la fauna mediterránea española.

Por otra parte, en los últimos años el número de especies descritas de *Alvania* se ha incrementado también considerablemente por el descubrimiento de nuevas especies procedentes de las islas macaronésicas, la costa africana o de los promontorios submarinos del atlántico nororiental (Amati, 1987; Gofas, 1989, 1990, 1999, 2007; Moolenbeek y Hoenselaar, 1989, 1998; Bouchet y Warén, 1993; van der Linden, 1993; Hoenselaar y Goud, 1998; Segers, 1999).

Obviamente, las islas Baleares no podían ser una excepción a los endemismos insulares dentro del género y así lo hemos constatado con el hallazgo de dos nuevas especies del mismo, comunes en el mar balear.

MATERIAL Y MÉTODOS

Los ejemplares estudiados en el presente trabajo proceden principalmente del estudio de los sedimentos recogidos durante la campaña oceanográfica Fauna III (dentro del proyecto Fauna Ibérica) mediante buceo y depositados en el Museo Nacional de Ciencias Naturales de Madrid (MNCN). Además se han estudiado también sedimentos recogidos por los autores en algunos puntos de Ibiza y Menorca.

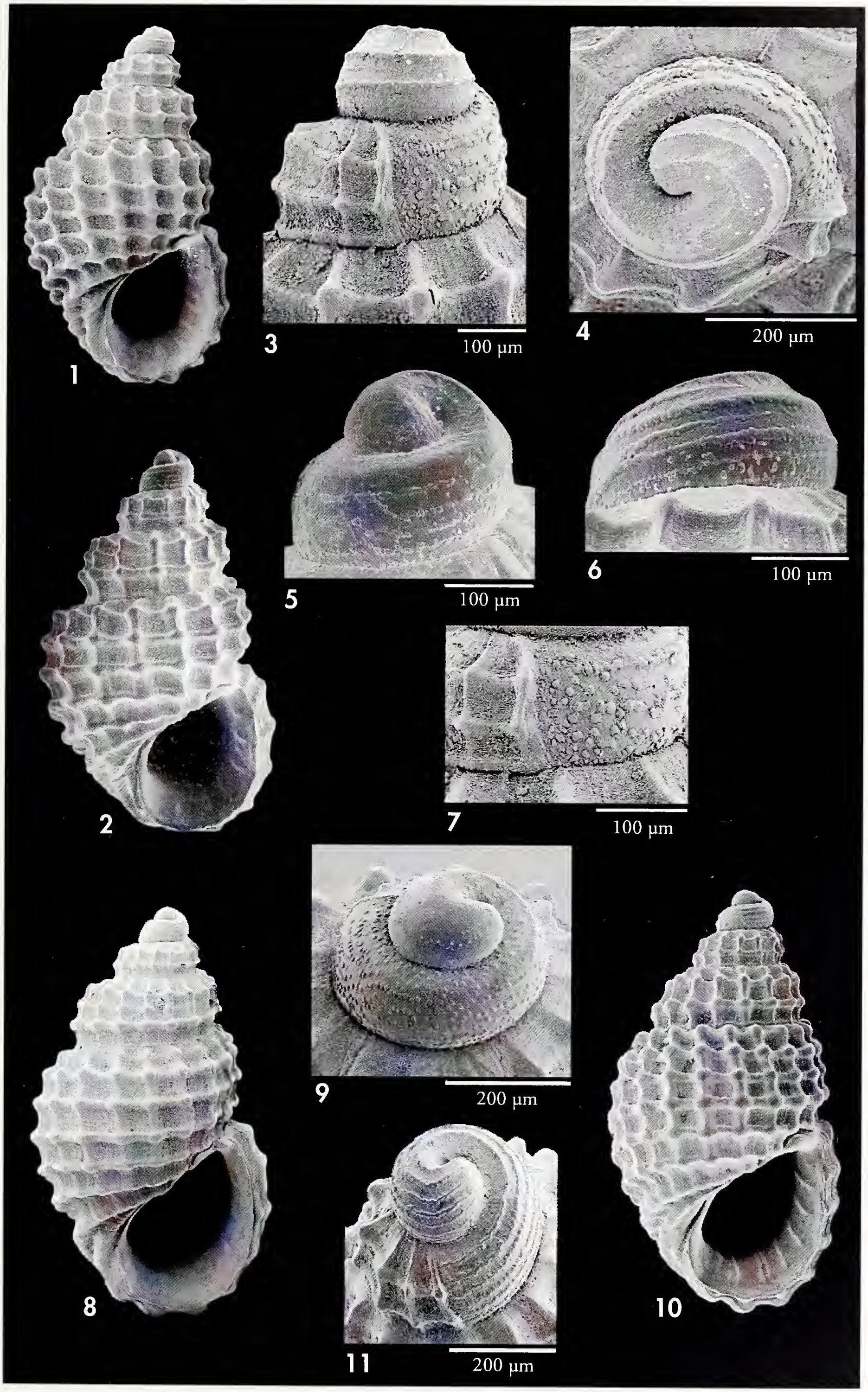
Los ejemplares han sido examinados, medidos y fotografiados mediante una lupa binocular y por medio de un microscopio electrónico de barrido.

DESCRIPCIÓN

Alvania balearica spec. nov. (Figs. 1-7, 28)

Material tipo: Holotipo y paratipos (14 ejemplares, todos de la localidad tipo) depositados en el Museo Nacional de Ciencias Naturales de Madrid (número de catálogo: 1505/47057).
Localidad tipo: Islote de S'Espartar, en la costa occidental de Ibiza, islas Baleares, a 25 m de profundidad (coordenadas geográficas: 38° 58′ 10″ N - 01° 09′ 24″ E).

(Página derecha) Figuras 1-7. *A. balearica* spec. nov.1: paratipo, 2,1 mm, Ibiza; 2: concha, 2,3 mm, islas Columbretes; 3: vista lateral de la protoconcha, Ibiza; 4: vista apical de la protoconcha, Ibiza; 5: detalle de la protoconcha, islas Columbretes; 6: detalle de la ornamentación de la protoconcha, islas Columbretes; 7: detalle de la transición protoconcha/teloconcha, Ibiza. Figuras 8, 9. *A. subcrenulata*. 8: concha, 2,5 mm, Ibiza; 9: vista apical de la protoconcha, Ibiza. Figuras 10, 11. *A. nestaresi*. 10: concha, 2,4 mm, La Herradura; 11: vista apical de la protoconcha, La Herradura.
(Right page) Figures 1-7. A. balearica *spec. nov.1: paratype, 2.1 mm, Ibiza; 2: shell, 2.3 mm, Columbretes Islands; 3: lateral view of the protoconch, Ibiza; 4: apical view of the protoconch, Ibiza; 5: detail of the protoconch, Columbretes Islands; 6: detail of the microsculpture of the protoconch, Columbretes Islands; 7: detail of the transition between protoconch and teleoconch, Ibiza. Figures 8, 9.* A. subcrenulata. *8: shell, 2.5 mm, Ibiza; 9: apical view of the protoconch, Ibiza. Figuras 10, 11.* A. nestaresi. *10: shell, 2.4 mm, La Herradura; 11: apical view of the protoconch, La Herradura.*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Otro material estudiado: Se han estudiado más de 1.300 ejemplares de las islas Columbretes y más de 700 de distintos puntos de Ibiza, Mallorca y Menorca (islas Baleares).
Etimología: El nombre de la especie hace referencia a su abundancia en el mar balear, del que parece ser endémica.

Descripción: Especie en apariencia muy similar a *A. subcrenulata* y *A. nestaresi*. Concha del holotipo (Fig. 28) con 3,5 vueltas de espira, 2,25 mm de altura y 1,25 mm de anchura. Forma algo turriculada, ornamentada por costillas y cordones casi de la misma anchura y que al cruzarse forman tubérculos algo puntiagudos. Penúltima vuelta de espira con tres cordones suprabucales, uno a la altura de la inserción labial y tres basales, que delimitan surcos bastante profundos. A gran aumento se observa una microescultura de diminutos gránulos, similar a la de *Alvania cancellata* (Da Costa, 1778). Interior del labio externo dentado.

Color de la concha blanquecino, con dos bandas longitudinales pardo-amarillentas sobre la última espira (Fig. 28). La superior, más estrecha, es subsutural y la inferior, más ancha, discurre por debajo de la línea donde se produce la inserción del labio externo. Por la parte externa del labio, un poco antes del engrosamiento labial, ambas franjas tienden a juntarse. Columela e interior del labio externo de color blanco.

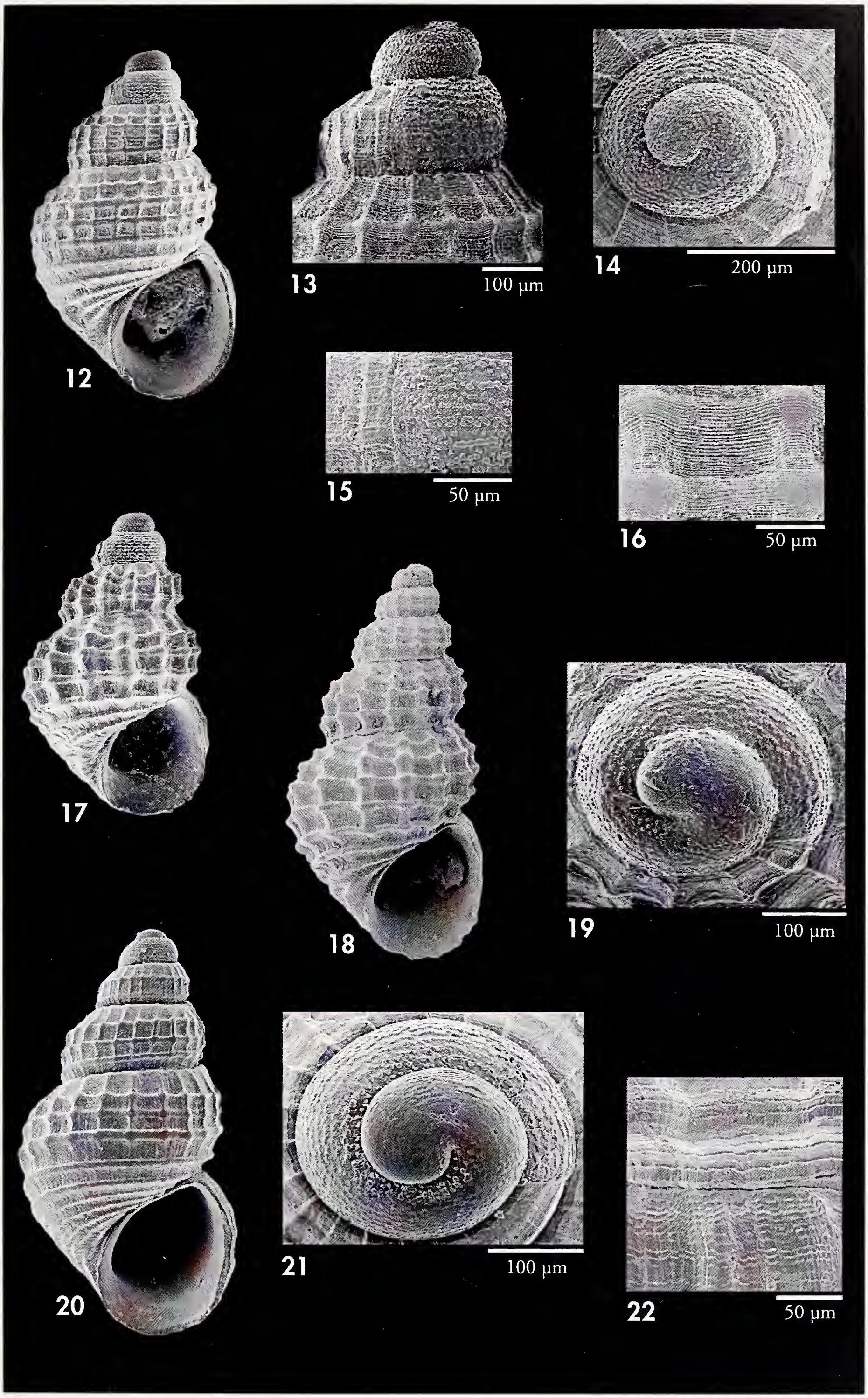
Protoconcha paucispiral con un núcleo claramente inclinado (Figs. 3-5). Las dimensiones de la protoconcha del holotipo fueron: nº de vueltas 1,35; diámetro del núcleo 95 μm; anchura de la primera media vuelta de espira 205 μm; anchura de la primera vuelta de espira 295 μm; diámetro máximo 345 μm; altura 350 μm. La ornamentación se inicia con tres cordones aquillados (Fig. 4), que se ven incluso con una lupa de pocos aumentos, y que a mitad de la protoconcha se convierten en gránulos gruesos toscamente alineados (Fig. 5). Entre los cordones espirales pueden apreciarse a veces esbozos de cordones incompletos (Fig. 6). La transición con la teloconcha (Figs. 3 y 7) es brusca. Ésta se inicia ya con dos gruesas costillas.

A pesar del elevado número de ejemplares estudiados, no se observa apenas variabilidad en los caracteres de la concha (tamaño, forma y color). En los ejemplares de las islas Columbretes la sutura es ligeramente más pronunciada que en los de las Baleares.

Biología y distribución: La mayor parte de los ejemplares se han hallado en sedimentos entre 20-40 metros de profundidad. Los sedimentos de donde se han extraído proceden casi todos de zonas con dominancia de comunidades de algas infralitorales profundas (algas hemiesciáfilas). Una descripción de esta comunidad en el archipiélago de las Columbretes puede verse en el libro de Templado y Calvo (2002, págs. 97-100).

A. balearica parece sustituir a *A. nestaresi* en el mar Balear. En algunas localidades de Baleares, como en los islotes occidentales de Ibiza o en el norte de

(Página derecha) Figuras 12-16: *A. josefoi* spec. nov., Tagomago (Ibiza). 12: holotipo, 1,8 mm; 13: vista lateral de la protoconcha; 14: vista apical de la protoconcha; 15: detalle de la microescultura de la protoconcha; 16: detalle de la microescultura de la teloconcha. Figuras 17-19. *A. scabra*. 17: ejemplar con la misma coloración que *A. josefoi*, 1,4 mm, Ibiza; 18: ejemplar de La Herradura, 2,4 mm; 19: vista apical de la protoconcha. Figuras 20-22. *A. sculptilis*, Getares. 20: concha, 2,1 mm; 21: vista apical de la protoconcha; 22: detalle de la microescultura de la teloconcha.
(Right page) Figuras 12-16: A. josefoi *spec. nov., Tagomago (Ibiza). 12: holotype, 1.8 mm; 13: lateral view of the protoconch; 14: apical view of the protoconch; 15: detail of the microesculpture of the protoconch; 16: detail of the microesculpture of the teleoconch. Figuras 17-19.* A. scabra. *17: specimen with the same colour pattern than that of* A. josefoi, *1.4 mm, Ibiza; 18: specimen from La Herradura, 2.4 mm; 19: apical view of the protoconch. Figuras 20-22.* A. sculptilis, *Getares. 20: shell, 2.1 mm, 21: apical view of the protoconch; 22: detail of the microesculpture of the teleoconch.*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13
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Menorca, aparece en sedimentos junto con *A. subcrenulata*, si bien esta última es mucho más escasa.

Discusión: Oliverio y Amati (1990) consideran que *A. subcrenulata* es un taxón confuso, y que este nombre se ha utilizado en el pasado seguramente para un complejo de especies próximas. Algunas de las especies pertenecientes a este complejo serían *Alvania amatii* Oliverio, 1986, del Mediterráneo oriental, *A. aartseni* Verduin, 1986, de las costas del norte de África, y *A. nestaresi* Oliverio y Amati, 1990, del Mediterráneo suroccidental. Asimismo, los ejemplares identificados por Oliverio y Amati (1989) como *A. aartseni* (de la colección Locard del MNHN de París), procedentes del sur de Francia, pudieran pertenecer a otra especie de este complejo. *Alvania balearica* sería una nueva especie perteneciente a este complejo, cuya área de distribución en el archipiélago balear se solapa con la de *A. subcrenulata*.

De esta última especie se diferencia por presentar *A. balearica* un perfil más turriculado y un cordón subsutural no tan evidente (se reduce a un reborde) como en *A. subcrenulata* (Figs. 8, 19). Asimismo, los cordones espirales son algo más gruesos y los tubérculos más sobresalientes. Por otro lado, la protoconcha de *A. balearica* está ornamentada por tres cordones aquillados que a mitad de la protoconcha se convierten en gránulos gruesos toscamente alineados. En *A. subcrenulata* la protoconcha presenta una ligera cresta en la porción mediosuperior de la espira y está ornamentada por gruesos tubérculos, en lugar de cordones (Fig. 9).

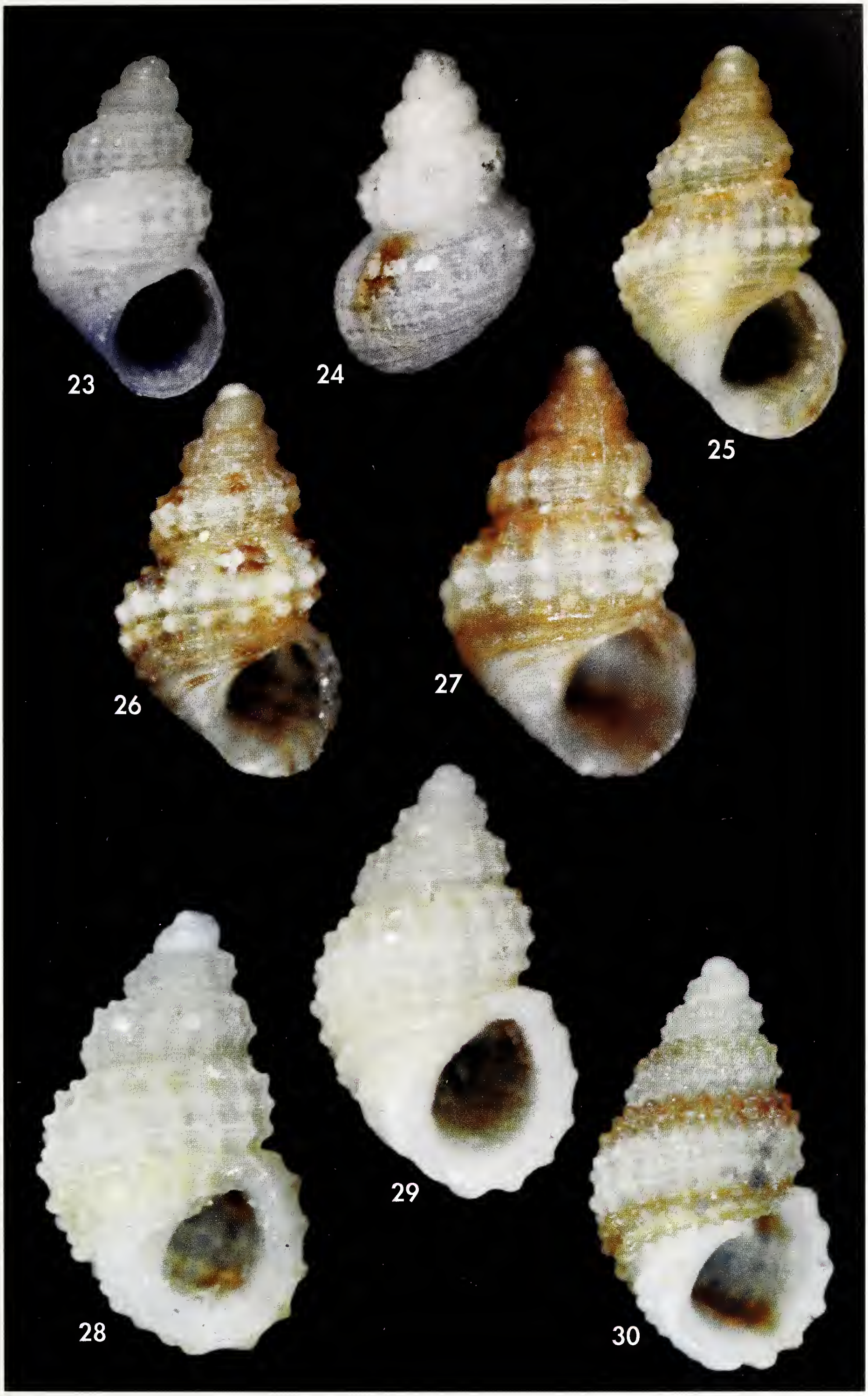
De *A. nestaresi* (Figs. 10, 30) se diferencia por presentar también un perfil más turriculado, menor número de cordones espirales (tres cordones suprabucales en la última espira en *A. balearica*, frente a cuatro en *A. nestaresi*). La escultura de la protoconcha de *A. nestaresi* consta de cinco o seis cordoncillos espirales que llegan hasta el final de la protoconcha (Fig. 11), mientras que la de *A. balearica* sólo tiene tres cordones que no llegan hasta el final. *A. nestaresi* es una especie muy abundante en el sur y sureste peninsular, que en las islas Columbretes y Baleares parece ser sustituida por *A. balearica*, muy abundante en este entorno geográfico y que parece vivir en un hábitat similar.

Otra especie parecida a *A. balearica* en tamaño, color, escultura y microescultura de la concha es *A. amati*, del Mediterráneo oriental. La separación geográfica de ambas especies y el hecho de que las dos tengan una protoconcha paucispiral (indicativo de una fase larvaria muy corta o ausente, lo que en principio limitaría la capacidad de dispersión), y algunos detalles de la escultura de sus protoconchas descartan la posibilidad de que puedan ser consideradas como una única especie. La protoconcha de *A. balearica* es más alta que la de *A. amati*, tiene tres cordones espirales frente a los cuatro o cinco de *A. amati* y el granulado final es menos denso y grueso que en *A. amati*.

De *Alvania aartseni*, del norte de África, se diferencia sobre todo porque en esta última especie la escultura de la protoconcha no presenta los tres cordones iniciales.

(Página derecha) Figuras 23, 24. *A. josefoi* nov. spec., islotes occidentales de Ibiza, paratipos de 1,5 y 1,7 mm, respectivamente. Figura 25. *A. sculptilis*, Algeciras, 2 mm. Figuras 26, 27. *A. scabra*, islas Columbretes, ejemplares de 2,0 y 2,1 mm respectivamente. Figura 28. *A. balearica* nov. spec., islotes occidentales de Ibiza, holotipo, 2,25 x 1,25 mm. Figura 29. *A. subcrenulata*, Algeciras, 2,8 mm. Figura 30. *A. nestaresi*, Cabo Palos, 2,6 mm.

(Right page) Figures 23, 24. A. josefoi *nov. spec., western inlets of Ibiza, paratypes of 1.5 and 1.7 mm, respectively. Figure 25. A. sculptilis, Algeciras, 2 mm. Figures 26, 27.* A. scabra, *Columbretes Islands, specimens of 2.0 and 2.1 mm respectively. Figure 28.* A. balearica *nov. spec., western inlets of Ibiza, holotype, 2,25 x 1,25 mm. Figure 29.* A. subcrenulata, *Algeciras, 2.8 mm. Figure 30.* A. nestaresi, *Cabo Palos, 2.6 mm.*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La especie *A. sleursi* Amati, 1987, endémica de Azores, también presenta un cierto parecido con *A. balearica*. En *A. sleursi* hay dos cordones suprabucales mientras que en *A. balearica* las conchas adultas tienen tres (aunque las subadultas tienen dos). La protoconcha de *A. sleursi*, al igual que la de *A. balearica* tiene tres cordones espirales, pero en la primera llegan hasta el final de la protoconcha, mientras que en la segunda dichos cordones se transforman en gránulos.

Alvania josefoi nov. sp. (Figs. 12-16. 23-24)

Material tipo: Holotipo y paratipos (9 ejemplares, todos de la localidad tipo) procedentes de la muestra 236B18 de la campaña oceanográfica Fauna III y depositados en el Museo Nacional de Ciencias Naturales (nº de catálogo: 1505/47058).
Localidad tipo: Al sur de la isla Tagomago (Ibiza, islas Baleares) (coordenadas geográficas: 39º 01′ 80″N - 01º 39′ 14″E).
Otro material estudiado: Se han estudiado más de 100 ejemplares procedentes de algunas islas e islotes de Ibiza y del sur y suroeste de Menorca (islas Baleares).
Etimología: La especie se dedica a la memoria de José Bedoya Romero "Josefo", ya fallecido, autor de algunas de las fotografías al microscopio electrónico de barrido del presente trabajo y gran amigo.

Descripción: Especie en apariencia muy similar a *A. scabra* y a *A. sculptilis*. Teloconcha del holotipo (Fig. 12) con tres vueltas de espira, 1,8 mm de altura y 0,9 mm de anchura. Perfil de las vueltas de espira convexo y ligeramente anguloso. Cuatro cordones longitudinales suprabucales claros en la última vuelta, que ya están presentes en la penúltima. Costillas verticales de grosor similar al de los cordones espirales, que al cruzarse forman pequeños tubérculos. Esta ornamentación confiere a la concha un aspecto reticulado. Abertura algo piriforme. Superficie de la concha con una microescultura muy característica, consistente en numerosos cordoncillos longitudinales muy juntos que le dan un aspecto estriado (Fig. 16). Interior del labio externo no dentado. Color blanco, algo traslúcido, con una evidente mancha marrón en la parte final de la última vuelta, justo por encima del labio externo.

Protoconcha del holotipo paucispiral (Figs. 13-15) con 1,45 vueltas. Diámetro del núcleo 90 μm; anchura de la primera media vuelta 190 μm; anchura de la primera vuelta 260 μm; diámetro máximo 335 μm; altura 265 μm. Ornamentada por gránulos muy juntos, algunos de ellos unidos longitudinalmente y dispuestos en una decena de filas poco delimitadas, en las que resulta casi imposible distinguir los interespacios (Fig. 15).

Existe una gran uniformidad en todos los ejemplares estudiados, tanto en el tamaño, como en la forma y color.

Biología y distribución: Sus conchas han sido encontradas preferentemente en detritos localizados entre 15 y 40 metros de profundidad en la proximidad de fondos rocosos con algas fotófilas y enclaves esciáfilos. Sólo se ha encontrado en el entorno de la isla de Ibiza y en algunos puntos de Menorca.

Discusión: Las especies ibéricas más parecidas a *A. josefoi* son *A. scabra* (Figs. 17-18, 26-27) y *A. sculptilis* (Figs. 20 y 25). Asimismo, la protoconcha indica su parentesco con estas dos especies. *A. scabra* convive con *A. josefoi*, pero es más común que ésta. Por otro lado, *A. sculptilis* es una especie típica del sur de la península ibérica y del norte de África (TRINGALI, 2001) que no ha sido localizada en las Baleares.

Los ejemplares de *A. scabra* que conviven con *A. josefoi* son algo mayores, tienen el perfil de espira más redondeado y la ornamentación más pronunciada. Además *A. scabra* tiene menos costillas y éstas suelen ser más anchas que los cordones, mientras que en *A. josefoi* son de anchura similar. En la teloconcha de *A. scabra* se observa también una una microescultura formada por débiles cordoncillos situados entre los cordones espirales, pero sin el aspecto estriado que se aprecia

en *A. josefoi*. Por último, la protoconcha de *A. scabra* (Fig. 19) presenta los gránulos más alineados que en *A. josefoi*.

A. sculptilis también es de mayor tamaño que *A. josefoi* y además su concha es amarillenta con manchas marrones y con tendencia a ser traslúcida, mientras que el patrón de coloración de *A. josefoi* es constante en todas las conchas examinadas. La microescultura de la protoconcha y teloconcha de *A. sculptilis* son más similares a las de *A. scabra* que a las de *A. josefoi*.

En las islas Canarias existen otras dos especies de *Alvania* pertenecientes a este grupo: *A. canariensis* (D'Orbigny, 1939) y *A. grancanariensis* Segers, 1999. Ambas se diferencian sobre todo a primera vista por el color del ápice, negruzco en la primera y amarillo dorado en la segunda (ver SEGERS, 1999).

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Proneomeniidae (Solenogastres, Cavibelonia) from the Bentart-2006 Expedition, with description of a new species

Proneomeniidae (Solenogastres, Cavibelonia) de la Campaña Bentart-2006, con la descripción de una nueva especie

Oscar GARCÍA-ÁLVAREZ*, María ZAMARRO** and Victoriano URGORRI*

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ABSTRACT

During the Spanish oceanographic expedition for the study of Antarctic benthos, Bentart-2006, carried out in the area of the Bellingshausen Sea and Antarctic Peninsula, seven specimens of Proneomeniidae (Solenogastres, Cavibelonia) were obtained. *Proneomenia bulbosa* sp. nov. is described here. A comparative table of the main specific characters of the species belonging to the genus *Proneomenia* is also included. New data of *Dorymenia usarpi* Salvini-Plawen, 1978 and *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000 are presented here.

RESUMEN

Durante la campaña oceanográfica española para el estudio del bentos antártico, Bentart-2006, se recogieron en el área del Mar de Bellingshausen y la Península Antártica siete especimenes de Proneomeniidae (Solenogastres, Cavibelonia). Se describe *Proneomenia bulbosa* sp. nov. Se incluye una tabla comparativa de los principales caracteres de las especies pertenecientes al género *Proneomenia*. Se presentan nuevos datos de *Dorymenia usarpi* Salvini-Plawen, 1978 y de *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000.

INTRODUCTION

The family Proneomeniidae is highly homogeneous, comprising species that are generally over 1 cm in length, most of them measuring between 2 and 5 cm long. They are characterized by presenting a thick cuticle with several layers of hollow acicular sclerites, a polystichous/polyserial radula and ventrolateral foregut glandular organs with a paired duct of epithelially arranged gland cells surrounded by musculature (type C according to SALVINI-PLAWEN, 1978a; *Epimenia* type according to HANDL AND TODT, 2005). The family includes two genera: *Proneomenia* and *Dorymenia*, which differ in the absence/presence of copulatory stylets.

The genus *Proneomenia* includes ten species, four of which belong to the Antarctic and Subantarctic biogeographic areas (SALVINI-PLAWEN, 1978a): *Proneomenia epibionta* Salvini-Plawen,

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1978 and *Proneomenia stillerythrocytica* Salvini-Plawen, 1978 were collected near the Falkland Islands; *Proneomenia praedatoria* Salvini-Plawen, 1978 comes from the Kerguelen Islands and Drake Passage. Only *Proneomenia gerlachei* Pelseneer, 1901 was collected in the same biogeographic area as *Proneomenia bulbosa* sp. nov., from the Bellingshausen Sea.

The genus *Dorymenia*, one of the largest of this class, includes twenty-four species, seventeen of which come from the Antarctic and Subantarctic biogeographic areas (SALVINI-PLAWEN, 1978a; GARCÍA-ÁLVAREZ *ET AL.*, 1998; 2000, GARCÍA-ÁLVAREZ AND URGORRI, 2003). The two species of this genus studied herein, *Dorymenia usarpi* Salvini-Plawen, 1978 and *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000, come from South Shetland Islands, an area in which six other species are known: *Dorymenia acutidentata* Salvini-Plawen, 1978, *Dorymenia cristata* Salvini-Plawen, 1978, *Dorymenia hesperidesi* García-Álvarez, Urgorri and Salvini-Plawen, 2000, *Dorymenia hoffmani* Salvini-Plawen, 1978, *Dorymenia parvidentata* García-Álvarez and Urgorri, 2003 and *Dorymenia troncosoi* García-Álvarez, Urgorri and Salvini-Plawen, 1998.

MATERIAL AND METHODS

The seven specimens studied were collected in three stations sampled during the expedition Bentart-2006, which was carried out on board the BIO Hespérides in January-February 2006 at Bellingshausen Sea and the Antarctic Peninsula. Specimens were fixed and preserved in 70% ethanol. For the study of sclerites, small pieces of cuticle of the dorsal middle part of the body and of the ventral groove were separated. These pieces were treated with sodium hypochlorite at 5% for 12 hours to isolate the sclerites. They were then washed with water, dried in a drying chamber at 40°C and mounted in Canada balsam. For their anatomical study, specimens were decalcified in an EDTA solution for 12 hours, they were embedded in paraffin, cut in transverse series of 10 μm in section, stained with Mallory trichromic and the reconstruction of the internal anatomy of their anterior and posterior body was performed.

SYSTEMATICS

Family Proneomeniidae Simroth, 1893

Diagnosis: See SALVINI-PLAWEN, 1978a; GARCÍA-ÁLVAREZ AND SALVINI-PLAWEN, 2007

Genus *Proneomenia* Hubrecht, 1880

Diagnosis: See SALVINI-PLAWEN, 1978a; GARCÍA-ÁLVAREZ AND SALVINI-PLAWEN, 2007
Type species: *Proneomenia sluiteri* Hubrecht, 1880

Proneomenia bulbosa sp. nov. (Figs. 1, 2)

Type material: Holotype 1 specimen 43 x 2.5 mm, cut in serial sections. Bellingshausen Sea (Antartica). Bentart-2006, Station MB 34-2; coordinates: 70° 11.620′ S, 84° 8.694′ W; 603 m depth. The holotype, cut in serial sections, is deposited in the Museo Nacional de Ciencias Naturales of Madrid, number MNCN 15.02/25.
Etymology: From Latin *bulbus*, bulb, regarding the posterior body of the bulging body.

Diagnosis: Body without protuberances and keels, with a bulging and acuminate posterior body. 300 μm thick cuticle. Hollow acicular sclerites (130-

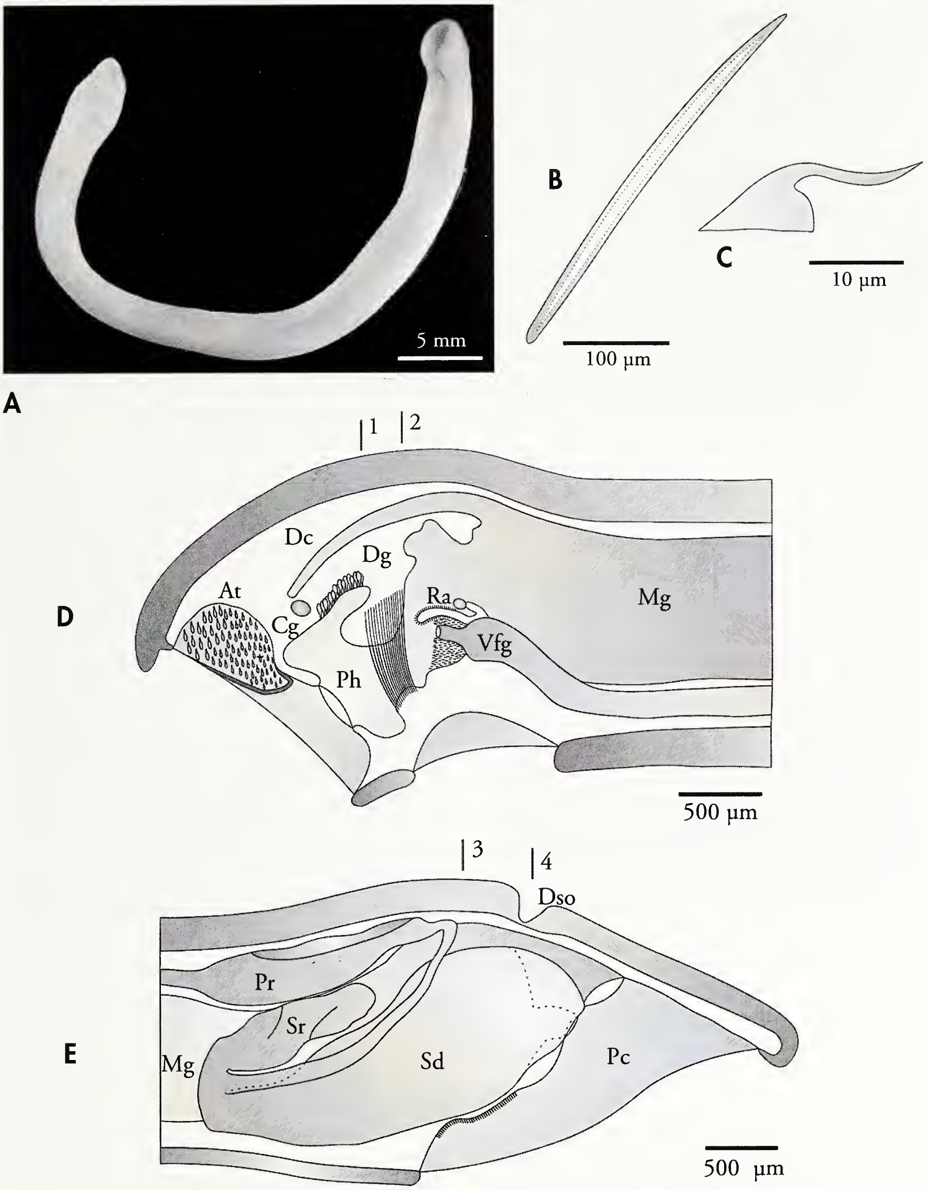

Figure 1. *Proneomenia bulbosa* sp. nov. A: habitus; B: hollow sclerites; C: radular tooth; D: schematic organization of the anterior body; E: schematic organization of the posterior body. Abbreviations, At: atrial sense organ; Cg: cerebral ganglion; Dc: dorsal caecum; Dg: dorsal gland; Dso: dorsoterminal sense organ; Mg: midgut; Pc: pallial cavity; Ph: pharynx; Pr: pericardium; Ra: radula apparatus; Sd: spawning duct; Sr: seminal receptacle; Vfg: ventral foregut glandular organ.

Figura 1. Proneomenia bulbosa *sp. nov. A: habitus; B: escleritos huecos; C: diente radular; D: esquema de la organización de la parte anterior; E: esquema de la organización de la parte posterior. Abreviaturas, At: órgano sensitive atrial; Cg: ganglio cerebral; Dc: ciego dorsal; Dg: glándula dorsal; Dso: órgano sensitivo dorsoterminal; Mg: intestino; Pc: cavidad paleal; Ph: faringe; Pr: pericardio; Ra: aparato radular; Sd: conducto de desove; Sr: receptáculo seminal; Vfg: órgano glandular ventral de la faringe.*

450 μm long). With one fold in the pedal groove that enters the pallial cavity. Dorsal pharynx gland present. Radula with 22-25 small and identical teeth with a wide base and a sharp sigmoid end. Ventrolateral foregut glandular organs type C/*Epimenia* type. Two types of erythrocytes: some elongated without granulations and a longitudinal groove and others spherical with granulations. Opening of the posteriorly unpaired spawning duct through a narrow tube with a sphincter. Seminal receptacles elongate, slightly lobulate. Small pallial cavity without diverticles and respiratory folds, with an anterior ventral groove. Without copulatory stylets. With abdominal spicules. One dorsoterminal sense organ.

Description: *Habitus:* Specimen 43 mm long x 2.5 mm thick. Body of circular section, without protuberances and keels, with a bulging and acuminate posterior body and a truncated and slightly bulging anterior body (Fig. 1A). Very marked pedal groove. White colour in alcohol.

Mantle and pedal groove: Thick cuticle (up to 300 μm thick) with elongated epidermal papillae. Hollow acicular sclerites (130-450 μm long) with thick walls (5-7 μm thick), slightly curved, with a sharp distal end and a round proximal end (Fig. 1B). Sclerites are arranged in several interlacing layers, with the distal end slightly protruding from the cuticle, most of them are tangential or skeletal. The pedal groove presents one fold that enters the pallial cavity.

Pallial cavity. Small, without diverticles and respiratory folds and without copulatory stylets. It leads onto the outside through a narrow ventral longitudinal opening (Fig. 1E). In its middle part, it presents thick and glandulous ventrolateral walls with a large quantity of blood cells. The anus is located in the dorsal region of the cavity and the opening of the spawning duct is located ventrally to the anus, where it has a central position. The pallial cavity extends in its anterior region with a ventral groove that continues with the pedal groove and into which the fold of the pedal groove enters (Fig. 2C, D). The ventral groove of the pallial cavity is located below the posterior part of the spawning duct and it leads onto the outside through a narrow longitudinal opening that continues with the opening of the pallial cavity. The lateral walls of the ventral groove are thick and glandulous, the abdominal spicules are located on them.

Digestive system. It presents a common atriobuccal cavity (Fig. 1D). The mouth opens dorsally in the posterior part of the atriobuccal cavity. The pharynx presents, dorsally and ventrally, a pair of small caeca near the mouth, which possibly form when the pharynx infolds. The anterior region of the pharynx has thick lateral walls with glands; a dorsal gland, which is made up of a short duct into which the gland cells open, is located in its dorsal region (Fig. 1D, 2A). The middle region presents a circular musculature, which is thicker in its dorsal part (Fig. 1D, 2B). Wide posterior part of the pharynx with a less developed musculature layer. The radula is polystichous/polyserial, with 22-25 small, identical teeth in each transverse row (25 μm long from the base to their sharp end) with a wide base and a sharp and sigmoid end (Fig. 1C). The ventrolateral foregut glandular organs are type C according to Salvini-Plawen, 1978a or *Epimenia* type following Handl and Todt, 2005, are made up of a pair of ducts covered by a muscular envelope inside which there are glandular epithelial cells. They are two long narrow tubes of circular section (approximate diameter 250 μm) and extend ventrolaterally to the intestine in the middle area of the body (Fig. 1D). There is a muscular radular sac located ventrally to the radula, into which the ventrolateral foregut glandular organs open through two non-glandulous ducts. The pharynx opens into the intestine through a short oesophagus, whose walls are quite thick. In its anterior region, the intestine has a narrow dorsal caecum that reaches the buccal area and has lateral constrictions caused by the dorsoventral musculature. The rectum is narrow, of circular section and very

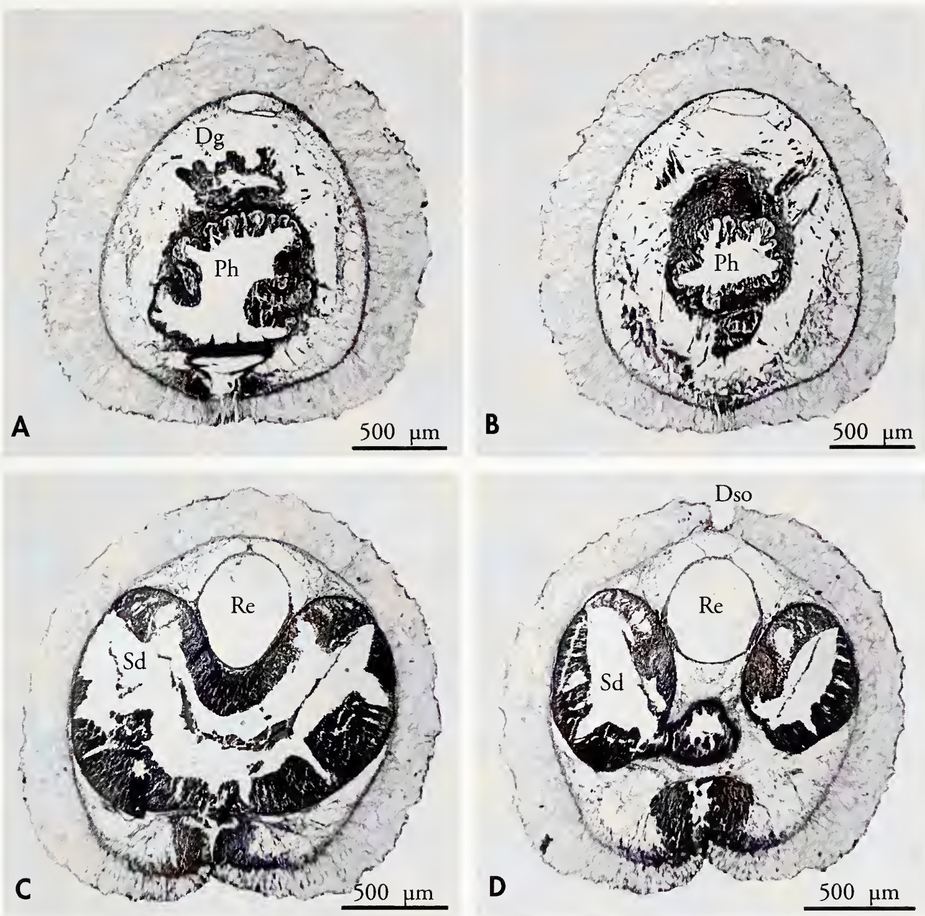

Figure 2. *Proneomenia bulbosa* sp. nov. A, B, C, D: cross sections corresponding to lines 1, 2, 3, 4 in Figure 1. Abbreviations, Dg: dorsal gland; Dso: dorsoterminal sense organ; Ph: pharynx; Re: rectum; Sd: spawning duct.

Figura 2. Proneomenia bulbosa *sp. nov. A, B, C, D: cortes en sección correspondientes a las líneas 1, 2, 3, 4 en la Figura 1. Abreviaturas, Dg: glándula dorsal; Dso: órgano sensitivo dorsoterminal; Ph: faringe; Re: recto; Sd: conducto de desove.*

close to the dorsal wall of the body due to the large size of the spawning duct (Fig. 2C, D). The anus is located in the dorsal region of the pallial cavity, it is wide and circular (approximate diameter 450 μm).

Nervous system and sense organs. The cerebral ganglion is located above the anterior part of the pharynx and the buccal ganglia are lateral to the posterior part of the radular area (Fig. 1D). The atrium is located in the anterior part of the common atriobuccal cavity, it has numerous digitiform papillae on its lateral walls and is delimited by a ventrolateral fold (Fig. 1D).There is a dorsoterminal sense organ in the dorsoposterior region of the body, above the rectum (Fig. 1E, 2D).

Gonopericardial system. The gonads were full of ova and spermatozoids, in their anterior part they are not separated and the blood sinus flows dorsally to them, whereas they are separated at their

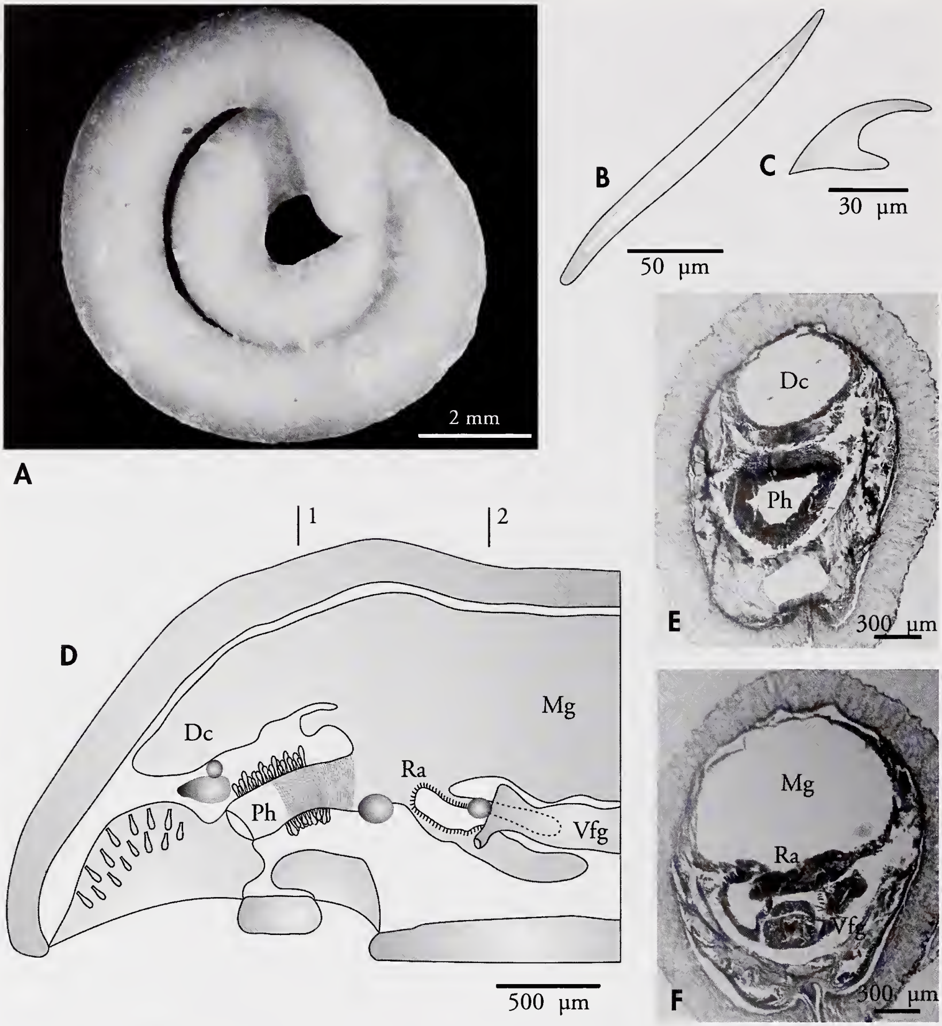

Figure 3. *Dorymenia usarpi* Salvini-Plawen, 1978. A: habitus; B: hollow sclerites; C: radular tooth; D: schematic organization of the anterior body; E, F: cross sections corresponding to lines 1, 2. Abbreviations, Dc: dorsal caecum; Mg: midgut; Ph: pharynx; Ra: radular apparatus; Vfg: ventral foregut glandular organ.

Figura 3. Dorymenia usarpi *Salvini-Plawen, 1978. A: habitus; B: escleritos huecos; C: diente radular; D: esquema de la organización de la parte anterior; E, F: cortes en sección correspondientes a las líneas 1, 2. Abreviaturas, Dc: ciego dorsal; Mg: intestino; Ph: faringe; Ra: aparato radular; Vfg: órgano glandular ventral de la faringe.*

posterior part and the sinus, full of blood cells, is located between them. There are two types of erythrocytes; some elongated (up to 14 μm long) without granulations or nucleus, with a longitudinal groove, and other spherical (diameter up to 10 μm) with granulations. The pair of gonopericardioducts are well separated, narrow (diameter of 90 μm) with slightly folded walls, projecting into the anterior part of the pericardium. The pericardium is flat and wide, the heart has an anterior,

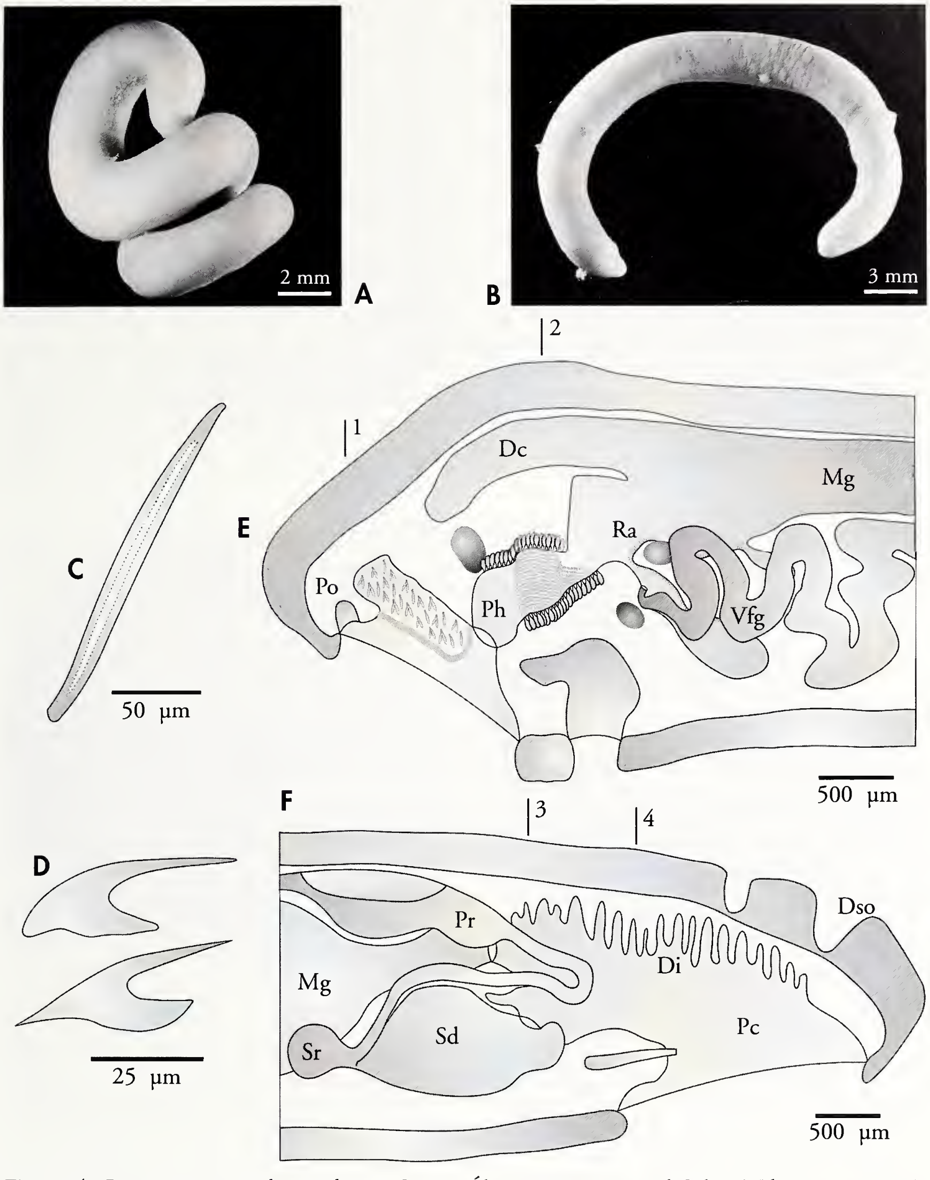

Figure 4. *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000. A: habitus; B: specimen with colonies of Bryozoa *Celleporella* sp.; C: hollow sclerites; D: radular teeth; E: schematic organization of the anterior body; F: schematic organization of the posterior body. Abbreviations, Dc: dorsal caecum; Di: diverticle; Dso: dorsoterminal sense organ; Mg: midgut; Pc: pallial cavity; Ph: pharynx; Po: preatrial organ Pr: pericardium; Ra: radula apparatus; Sd: spawning duct; Sr: seminal receptacle; Vfg: ventral foregut glandular organ.

Figura 4. Dorymenia menchuescribanae *García-Álvarez, Urgorri and Salvini-Plawen, 2000. A: habitus; B: especimen con colonias de Bryozoa* Celleporella *sp.; C: escleritos huecos; D: dientes radulares; E: esquema de la organización de la parte anterior; F: esquema de la organización de la parte posterior. Abreviaturas, Dc: ciego dorsal; Di: divertículo; Dso: órgano sensitivo dorsoterminal; Mg: intestino; Pc: cavidad paleal; Ph: faringe; Po: órgano preatrial; Pr: pericardio; Ra: aparato radular; Sd: conducto de desove; Sr: receptáculo seminal; Vfg: órgano glandular ventral de la faringe.*

wide and unpaired ventricle and two posterior and narrow auricles. Both pericardioducts come out laterally from the posterior part of the pericardium, they present their walls encircled by a circular musculature and the interior epithelium is folded. They join the dorsoanterior part of the spawning duct, in the same area where the seminal receptacles join (Fig. 1E). Both seminal receptacles are long, slightly lobulate and are located dorsally to the anterior part of the spawning ducts. The receptacles and the anterior part of the spawning ducts were full of spermatozoids. The spawning duct is paired in its anterior half, representing two tubular ducts that increase their diameter from their anterior part to their fusion and their walls are very glandulous. The unpaired spawning duct fills almost the whole body space (Fig. 1E, 2C), it opens into the pallial cavity through a narrow tube with a folded internal wall and a sphincter made up of a layer of circular musculature (Fig. 1E, 2D). Laterally to this narrow end tube, the spawning duct continues in the posterior part with two caeca of gland walls that reach the anterior wall of the pallial cavity (Fig. 1E, 2D), these caeca may form when the spawning duct is retracted, as these specimens protrude the end part of the spawning duct and all the pallial cavity.

Genus *Dorymenia* Heath, 1911

Diagnosis: See Salvini-Plawen, 1978a; García-Álvarez and Salvini-Plawen, 2007
Type species: *Dorymenia acuta* Heath, 1911

Dorymenia usarpi Salvini-Plawen, 1978 (Fig. 3)

Material examined: 1 specimen 29 mm long x 1.8 mm wide, cut in serial sections, Low Island (South Shetland Islands, Antarctica). Bentart-2006, Station LOW 45; coordinates 63° 43.171′ S, 62° 21.16′ W; 86 m depth.

Remarks: *Dorymenia usarpi* was known so far from Bransfield Strait, 311-426 m depth; South Orkney Islands, 485 m depth; and Ross Sea 342-732 m depth (Salvini-Plawen, 1978a). The first two records are very close to the present one, although they are at slightly greater depths. Three dorsoterminal sense organs were observed in the specimen studied here, whereas the original description showed just one or two. Although the bad histological state of the posterior body of the specimen did not make the description of the reproductive system possible, the dorsolateral bags of the pallial cavity typical of this species were visible. *Dorymenia hesperidesi*, a species close to *D. usarpi* described from the South Shetland Islands, presents clear differences regarding the size of the radular teeth and the erythrocytes shape (see Table I in García-Álvarez *et al.*, 2000).

Dorymenia menchuescribanae García-Álvarez, Urgorri and Salvini-Plawen, 2000 (Figs. 4, 5)

Material examined: 5 specimens 34-51 mm long x 2.5-3 mm wide, cut in serial sections. Miers Bluff, next to Falsa Bay (Livingston Island, South Shetland Islands, Antarctica); Bentart-2006, Station St GA; coordinates: Start: 62° 46.13′ S, 60° 27.02′ W, End: 62° 43.565′ S, 60° 27.486′ W; 42.8-50.2 m depth.

Remarks: The specimens studied herein were collected in the same geographic area and at a similar depth to those known before. They are large specimens, over 3 cm long, with a slightly acuminate posterior body and generally

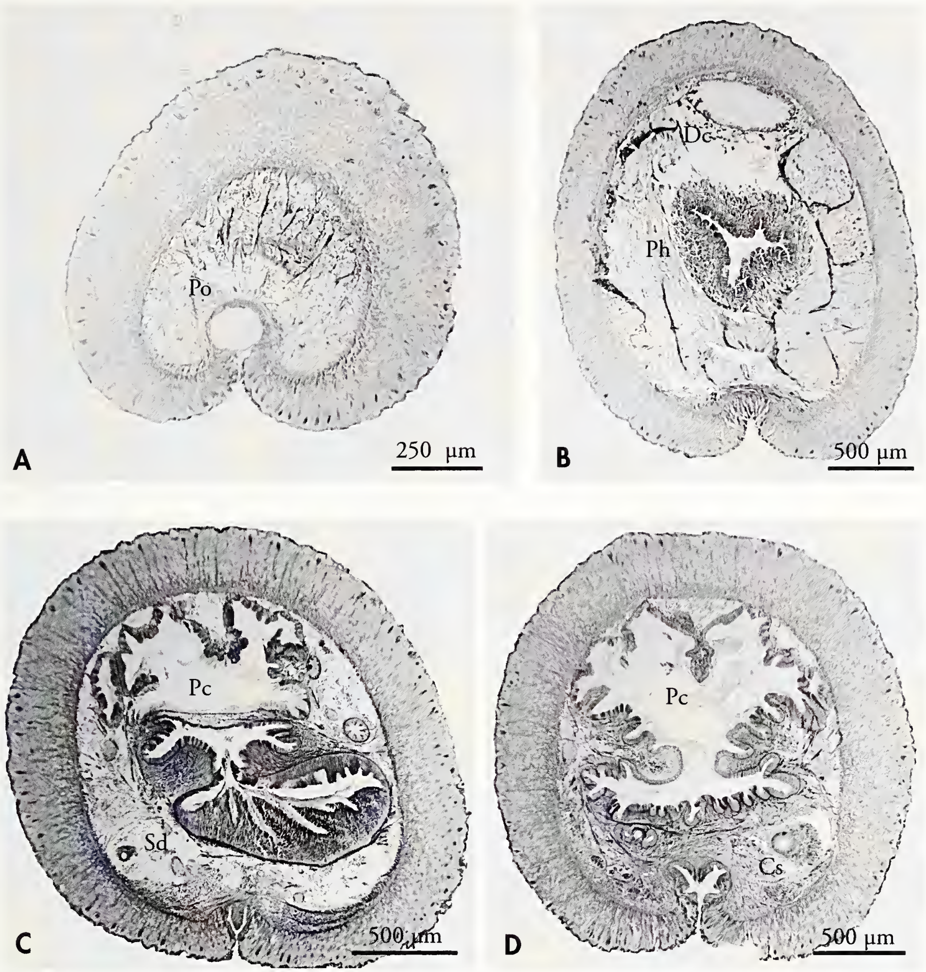

Figure 5. *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000. A, B, C, D: cross sections corresponding to lines 1, 2, 3, 4 in Figure 4. Abbreviations, Cs: copulatory stylet; Dc: dorsal caecum; Pc: pallial cavity; Ph: pharynx; Po: preatrial organ Sd: spawning duct.
Figura 5. Dorymenia menchuescribanae *García-Álvarez, Urgorri and Salvini-Plawen, 2000. A, B, C, D: cortes en sección correspondientes a las líneas 1, 2, 3, 4 en la Figura 4. Abreviaturas, Cs: estilete copulador; Dc: ciego dorsal; Pc: cavidad paleal; Ph: faringe; Po: órgano preatrial; Sd: conducto de desove.*

seem to be rolled up (GARCÍA-ÁLVAREZ *ET AL.*, 2000). Some unknown characteristics could be observed in these specimens; they present a preatrial sense organ in the atriobuccal cavity (Figs. 4E, 5A); the number of dorsoterminal sense organs varies from two to four; and the opening of the spawning duct into the ventral bag of the pallial cavity may have a frontal or ventral position (Figs. 4F, 5C), which may possibly vary according to the protruded state of the ventral bag and even of the cavity during copulation (see Table I in GARCÍA-ÁLVAREZ *ET AL.*, 2000). It should be pointed out finally that several colonies of Bryozoa *Celleporella* sp. were found on the cuticle in one of the specimens (Fig. 4B).

Table I. Comparative table of the main specific characters of species belonging to the genus *Proneomenia*.

	Distribution/ Depth	Habitus (mm)	Size (µm)	Cuticle (µm)
P. acuminata	E. coast USA, Caribbean Sea 250-650 m	Ends: anterior round and truncate; posterior pointed	20-30 x 1.7-1.8	Up to 250
P. desiderata	Marseille 20-30 m	Ciyindrical, without keels	10	Up to 130
P. epibionta	Falkland I. 646-845 m	With dorsal and lateral long protuberances	30 x 2	Up to 200
P. gerlachei	Bellingshausen Sea 550 m	Ciyindrical, without keels	45 x 2.5	Up to 400
P. hawaiiensis	Hawaian I. 270-500 m	Thick ends; anterior truncate; posterior pointed	36 x 2	Up to 120
P. insularis	Hawaian I. 1400-1800 m	Ciyindrical, without keels	?	Up to 90
P. praedatoria	Kerguelen I. Drake S. 585-1240 m	With dorsal protuberances	28 x 2.2	Up to 200; protuberance 350
P. sluiteri	Barents Sea, Spitzbergen, Kara Sea-Laptev Sea 45-300 m	Round ends. Thick anterior	105-148	Up to 100
P. stillerythrocytica	Falkland I. 512-586 m	With dorsal protuberances	37 x 2	Up to 150; protuberance 225
P. valdiviae	Zanzibar 748 m	Ends: anterior round and truncate; posterior pointed	37 x 2	Up to 100
P. bulbosa n.sp.	Bellingshausen Sea 603 m	Thick ends; anterior truncate; posterior pointed	43 x 2.5	Up to 300

DISCUSSION

Of the ten species described from the genus *Proneomenia*, only *Proneomenia gerlachei* Pelseneer, 1901 comes from the same biogeographic area and from a similar depth (Bellingshausen Sea, 70° 00′ S, 81° 50′ W, 550 m depth) (Salvini-Plawen, 1978a) to *Proneomenia bulbosa* sp. nov. Both species present clear differences (Table I): in *P. gerlachei*, the hollow acicular sclerites only reach a length of 100 µm, in each radular row there are 40 teeth with a narrow base and a pointed and small curved end, and the erythrocytes are oval (Salvini-Plawen, 1978a); whereas in *P. bulbosa* sp. nov. the hollow acicular sclerites are long, up to 450 µm in length, each radular transverse row comprises 22-25 teeth with a wide base and a pointed sharp end, and it has two types of erythrocytes: some are elongated without granulations and with a longitudinal groove, others are round with granulations (cf. Salvini-Plawen, 1978b).

Three species belong to the subantarctic biogeographic area (Salvini-Plawen, 1978a): *Proneomenia epibionta* Salvini-Plawen, 1978, *Proneomenia stillerythrocytica* Salvini-Plawen, 1978 (Falkland Islands, 646-845 m and 512-586 m depth respectively) and *Proneomenia praedatoria* Salvini-Plawen, 1978 (Kerguelen Islands, and Drake Straight, 585-1240 m depth). In *P. epibionta* the cuticle is thinner (200 µm) than in *P. bulbosa* sp. nov. (300 µm) and has dorsal and lateral protuberances. The hollow

Tabla I. Tabla comparativa de los principales caracteres específicos de las especies del género Proneomenia.

	Sclerites length (µm)	Dorsal pharynx gland	Radular teeth	Oesophagus	Erythrocytes shape	Opening spawning duct	Dorsoterminal sense organ
P. acuminata	Up to 450	Yes	28 Narrow base	Yes	Oval	Narrow and musculous end duct	1
P. desiderata	?	No	14 Narrow base	No	Drop	?	1
P. epibionta	Up to 200	No	42-46 Narrow base	No	Oval	Groove in the ventral wall of the pallial cavity	4
P. gerlachei	Up to 100	Yes	40 Narrow base	No	Oval	Musculous canal	1
P. hawaiiensis	Up to 330	Yes	38-45 Narrow base	Yes	Spherical	Narrow end duct	1
P. insularis	Up to 200	No	34 Narrow base	Yes	Spherical	?	?
P. praedatoria	Up to 350	Yes	45 Wide base	Yes	Drop	In the ventral wall of pallial cavity	1-2
P. sluiteri	Up to 200	No	19-20 Wide base	Yes	Oval	Without end duct	1
P. stillerythrocytica	?	No	44-52 Wide base	?	Drop	Groove in the ventral wall of the pallial cavity	3
P. valdiviae	Up to 430	Yes	18	?	Drop	In ventral protuberance to the anus	1
P. bulbosa n. sp.	Up to 450	Yes	22-25 Wide base	Yes	Elongated and spherical	Narrow and musculous end duct	1

acicular sclerites only reach 200 µm in length, in each radular row there are 42-46 teeth and they are much longer (80-100 µm) than in *P. bulbosa* sp. nov. (25 µm), there is no dorsal pharynx gland and the erythrocytes are oval. *P. stillerythrocytica* has a 150 µm thick cuticle with dorsal protuberances, it possesses 44-52 teeth per radular row similar to those of *P. epibionta* and it has no dorsal pharynx gland. In *P. praedatoria* the cuticle shows dorsal protuberances up to 350 µm thick and has 45 teeth per radular row with a length of 40-50 µm (Table I).

The six remaining species shows several differences (Table I): *Proneomenia acuminata* Wirén, 1892 (W. Indian Ocean, 550 m depth; Florida and Massachusetts (USA), 250-650 m depth) has no circular musculature in the pharynx, the 28 teeth per radular row have a narrow base and a non-curved sharp end, erythrocytes are oval with a central axis (HEATH, 1918). *Proneomenia desiderata* Kowalevsky and Marion, 1887 (Marseille, 20-30 m depth) has a radula with 14 teeth per transverse row, it has no dorsal pharynx gland, the pericardium shows two ventrolateral bags and erythrocytes are drop-shaped (KOWALEVSKY AND MARION, 1887). *Proneomenia hawaiiensis* Heath, 1905 and *Proneomenia insularis* Heath, 1911 were collected off Hawaii at 270-500 m and 1400-1800 m depth respectively. *P. hawaiiensis* has a radula with 38-45 teeth per transverse row with a narrow base and pointed ends. *P. insularis* has no dorsal pharynx gland and the radula shows 34

teeth per row (Heath, 1911). *Proneomenia sluiteri* Hubrecht, 1880 (Arctic Ocean: Barents Sea, 200-292 m depth; Spitzbergen (Svalbard Islands), Kara Sea to Laptev Sea, 45-300 m depth) has 200 μm long sclerites, it has no dorsal pharynx gland, the rectum presents a sphincter and the spawning duct is divided in two parts by a muscular constriction (Hubrecht, 1881). Finally, *Proneomenia valdiviae* Thiele, 1902 (Zanzibar (Indian Ocean), 748 m depth) has a 100 μm thick cuticle, 18 radular teeth per row and the opening of the spawning duct in the pallial cavity is very narrow and is located in a ventral protuberance to the anus (Thiele, 1902).

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The species of the genus *Belgrandia* (Caenogastropoda, Hydrobiidae) in the Iberian Peninsula

Las especies del género *Belgrandia* (Caenogastropoda, Hydrobiidae) en la Península Ibérica

Emilio ROLÁN* and Álvaro de OLIVEIRA**

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ABSTRACT

The species of the genus *Belgrandia* Bourguignat, 1869 from the Iberian Península are discussed. Four *taxa* were previously known, but some of them were considered as having subspecific level. A new species from Portugal is described: *B. silviae* spec. nov. Conchological, anatomical and radulae data are provided for all the species involved. The known geographic distribution area is given, reporting new localities for some of the species.

RESUMEN

Se discuten las especies pertenecientes al género *Belgrandia* Bourguignat, 1869 de la Península Ibérica. Cuatro taxones eran previamente conocidas, aunque alguno considerado en un nivel subespecífico. Se describe una nueva especie de Portugal: *B. silviae* spec. nov. Se muestran los caracteres de la concha y morfologia de las partes blandas y de las radulas de todas las especies incluidas. Se presenta la distribución conocida, aportando nuevas localidades para algunas de ellas.

INTRODUCTION

The genus *Belgrandia* Bourguignat, 1869 (Caenogastropoda, Hydrobiidae) is present in European springs and streams, in Dalmatia, southern France, Italy, Spain and Portugal, according to KABAT AND HERSHLER (1993). In their work the evolution of this genus, as well as its relationships and synonyms are commented upon. Some species from Portugal were described by French and German authors (PALADILHE, 1867; CLESSIN, 1878; BOETTGER, 1963). NOBRE (1930) did not admit the validity of these *taxa* and considered that all represent only forms of *B. gibba* (Draparnaud, 1805). This species lives in southern France (KABAT AND HERSHLER (1993) and it is improbable that populations of the same species are found as far away as Portugal, as admitted by BOETERS (1988). ROLÁN (1999) mentioned *B. lusitanica* (Paladilhe, 1867) informing that it is a species in risk of extinction due to the small area where it lives. HAASE (2000) published a revision on this genus in Europe includindg the species in the Iberian Peninsula.

Recently, new samplings collected by the junior author allowed us to get a better idea of the distribution area. The study of all this new material allowed us to compare populations collected in several localities in Portugal. Other samples had been collected by the senior author years ago.

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As far as we know, only one species is present in Eastern Spain, with few populations dispersed along a wide distribution range between Cataluña and Comunidad Valenciana. The situation in Portugal is quite the reverse, the genus exhibiting a significant radiation. In an area of only 90x50 km, four species are present, one of which, *B. silviae* spec. nov., is here described as new to science. This territory corresponds to the northern half of the Lusitanian Basin, in central western Portugal, which in the Upper Pliocene was still submerged.

Abbreviations:

MNCN Museo Nacional de Ciencias Naturales, Madrid
MHNG Museum d'Histoire Naturelle, Geneve
MHNS Museo de Historia Natural de la Universidad de Santiago de Compostela (collection of Emilio Rolán)
MNHN Museum National d'Histoire Naturelle, Paris
BMNH The Natural History Museum, London
MHNP Museu Nacional de História Natural, Faculdade de Ciências do Porto (former Museu de Zoologia Augusto Nobre)
SMF Naturmuseum und Forschungsanstalt Senckenberg, Frankfurt
CAO Collection of Álvaro de Oliveira
CHB Colection of Hans Boeters
sp live specimen
s empty shell

TAXONOMIC PART

Family HYDROBIIDAE Troschel, 1857
Genus *Belgrandia* Bourguignat, 1869

Type species: *Cyclostoma gibbum* Draparnaud, 1805.

Belgrandia lusitanica (Paladilhe, 1867) (Figs. 1-12, 69)

Hydrobia lusitanica Paladilhe, 1867. *Rev. Mag. Zool. Pure* appl. (2); 19: 92, pl. 21, figs. 1-4. [Type locality: Fonte das Lágrimas, after Coimbra, Portugal].
Belgrandia occidentalis Clessin, 1878. *Malakozool.* Bl., 25: 120, lám. 4, fig. 7-9. [Type locality: Coimbra, Portugal].
Belgrandia gibba Draparnaud, 1805. In NOBRE (1930: 205, fig. 36).

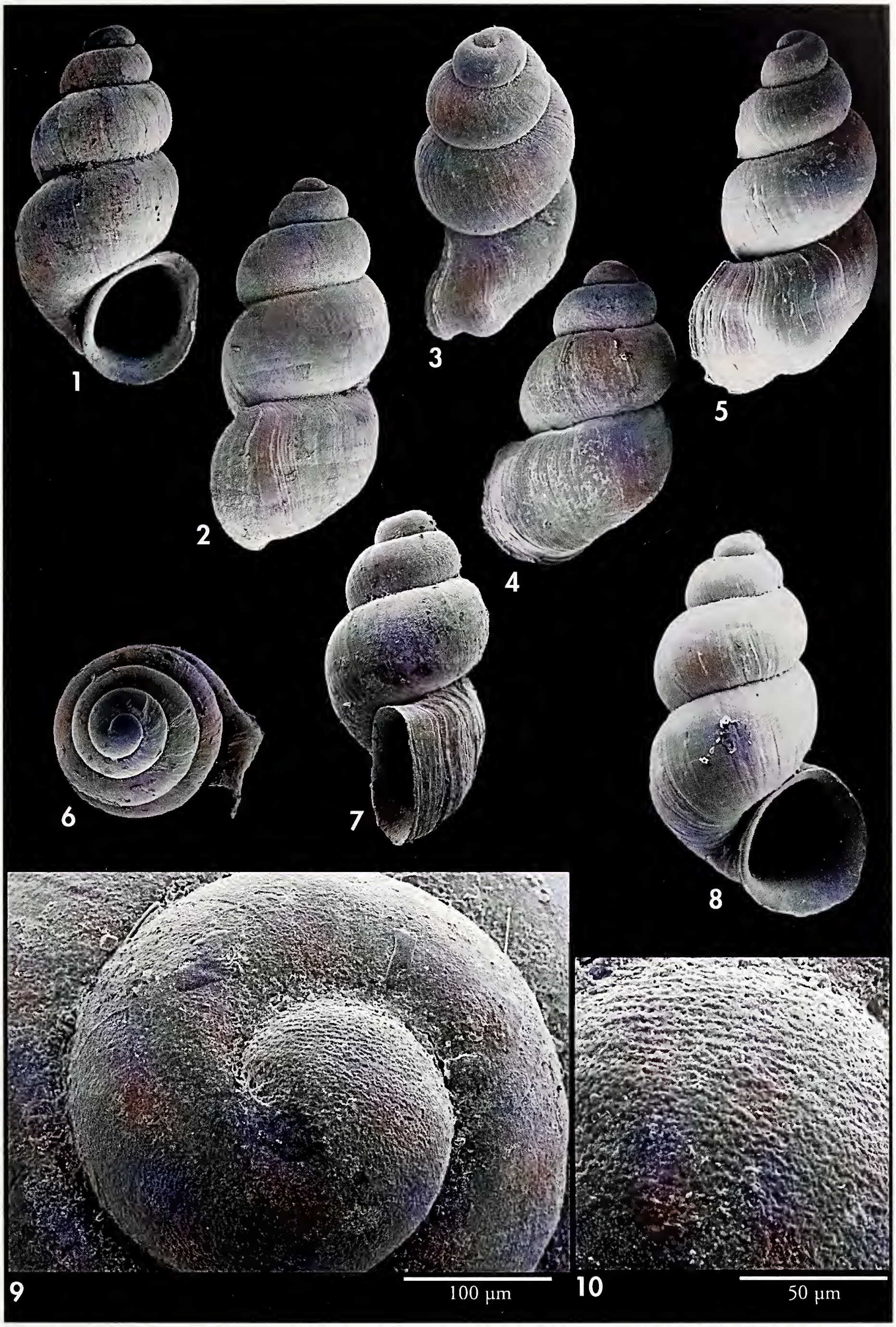
Type material: Lectotype designated and figured by HAASE (2000: fig. 3 E) in MHNG.
Type locality: Fonte das Lágrimas,
Other material studied: About 150 sp, leg. E. Rolán, (9-March-1989; 30-June-1990); 132 sp, leg. A. de Oliveira (5-January-2008). All from Fonte das Lágrimas, Quinta das Lágrimas, (NE4849), Coimbra, province of Beira Litoral, Portugal.

Description: Shell (Figs. 1-8) oval-cylindrical, somewhat elongated, whorls convex, with deep suture.

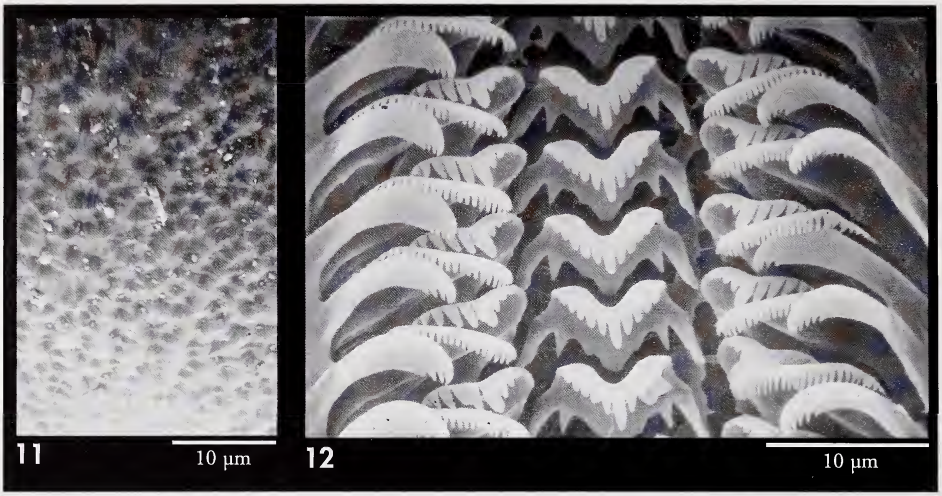
Protoconch (Fig. 9) with about 1 whorl, the separation from the teleoconch being very difficult to see; diameter: nucleus about 90 ?m; first ? whorl, about 240 ?m. Microsculpture (Fig. 10) with minute depressions, which with high magnification (Fig. 11) are seen as having geometrical shape and separation wall elevated and with numerous lines.

Teleoconch with about three whorls, with some irregular spiral lines and prosocline growth lines.

Aperture slightly ovoid, continuous and with a fine peristoma, a little undulating. Externally, a little before the end of the spire, there is an axially elongated thickening, very constant, only absent from juveniles.



Figures 1-10. *Belgrandia lusitanica* (Paladilhe, 1867). 1-8: shells, 1.6, 1.7, 1.5, 1.4, 1.6, 1.4, 1.5, 1.8 mm, Fonte das Lágrimas, Coimbra; 9: protoconch; 10: detail of the microsculpture.
Figuras 1-10. Belgrandia lusitanica *(Paladilhe, 1867). 1-8: conchas, 1,6; 1,7; 1,5; 1,4; 1,6; 1,4; 1,5 y 1,8 mm, Fonte das Lágrimas, Coimbra; 9: protoconcha; 10: detalle de la microescultura.*



Figures 11, 12. *Belgrandia lusitanica* (Paladilhe, 1867). 11: microsculpture of the protoconch; 12: radula.
Figuras 11, 12. Belgrandia lusitanica *(Paladilhe, 1867). 11: microescultura de la protoconcha; 12: rádula.*

Dimensions between 1.4 and 1.9 mm in height.

Animal (also described by NOBRE, 1930) dark, with tentacles dark with a white line in the middle; the dorsum of the head is dark, only light on spaces around the eyes and the anterior part of the snout; behind the eyes there is a triangular space with cream or cream-yellowish colour; the penis (Fig. 69) is elongated, sharp-pointed, with an angle near its base, a little black on its anterior part, with a small appendix on its left side. The sole of the foot is white.

The radula (Fig. 12) is typical of hydrobids, having a central tooth with about 10 cusps, the central one more prominent; lateral teeth similar, about ten cusps; the marginal ones are different, one with near 30 small and elongated cusps, and the other spoon like with only few cusps.

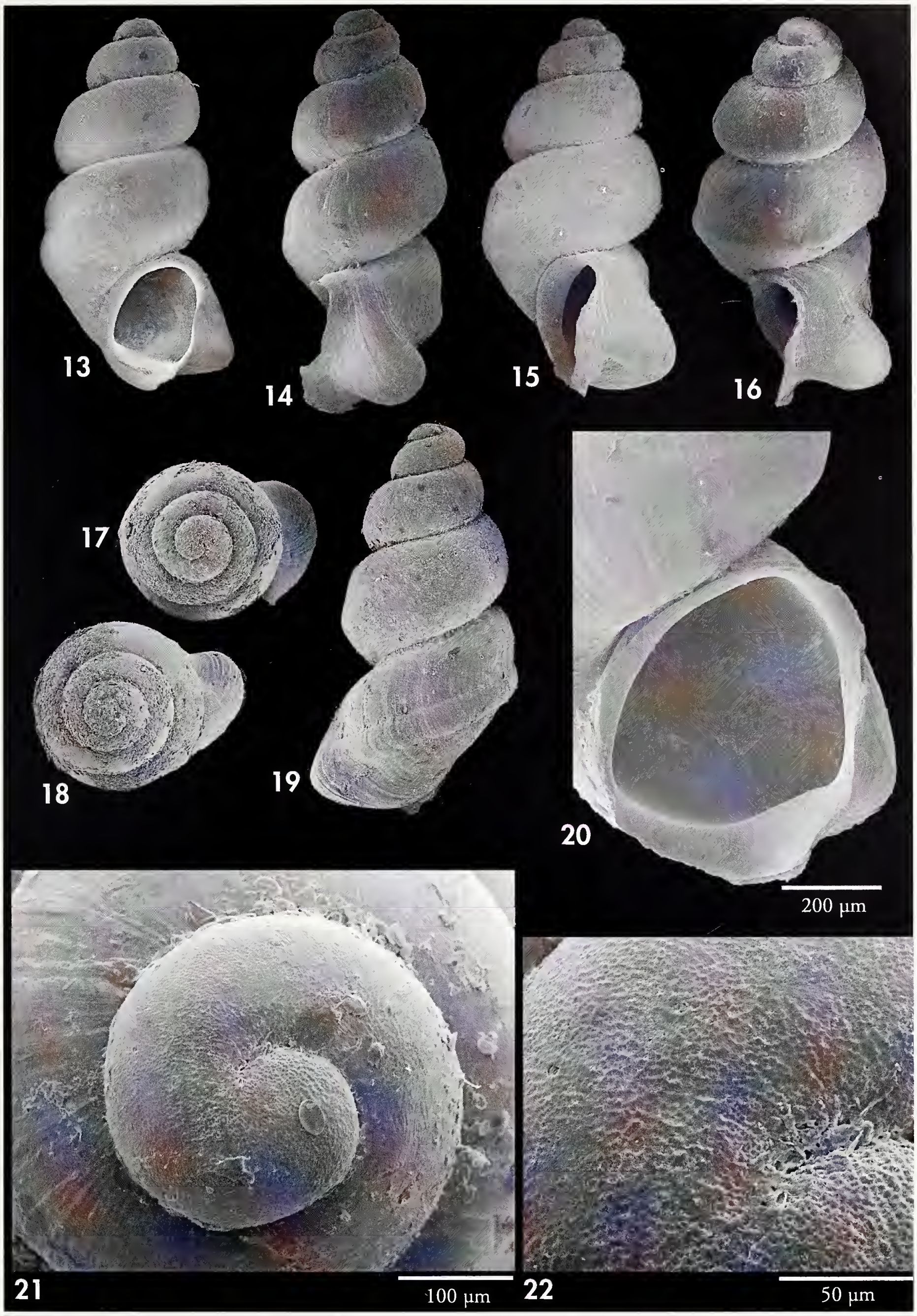
Habitat: Under decaying leaves and among moss, always in shady areas with running water. This species coexists with 4 other freshwater gastropods: *Theodoxus* cf. *fluviatilis* (LINNAEUS, 1758), *Potamopyrgus antipodarum* (GRAY J. E., 1843), *Mercuria tachoensis* (FRAUENFELD, 1865) and *Physella acuta* (DRAPARNAUD, 1805).

Distribution: Known from the type locality only (Fig. 78).

Remarks: The species has been mentioned by NOBRE (1930, as *B. gibba*), and the figure of NOBRE (1930, fig. 36) is characteristic of the specimens from Quinta das Lágrimas. Also represented in BOETERS (1988) and commented by ROLÁN (1990) who described the soft parts and represented the shell, with their characteristics and typical deposits of calcium carbonatum.

Hydrobia lusitanica Paladilhe, 1867 is clearly defined by the material studied from the type locality. The name *Belgrandia gibba* Draparnaud, 1805, which NOBRE (1930) considered to be the valid one for all the Portuguese species, concerns a species only present in Corsica and the South of France, probably referred erroneously for the northwest of Italy by COSSIGNANI ET AL. (1995), and so, improbably related with the Portuguese species.

Belgrandia lusitanica had been recorded by ROLÁN (1990) considering it in high risk of extinction. At present it is satisfactory



Figures 13-22 *Belgrandia silviae* spec. nov. 13: holotype, 2.0 mm (MNCN); 14-19: Paratypes, 1.9, 2.0, 1.7, 1.8, 1.8 and 1.9 mm (MNCN); 20: detail of the aperture in the holotype; 21: protoconch; 22: microsculpture of the protoconch.

Figuras 13-22 Belgrandia silviae *spec. nov. 13: holotipo, 2,0 mm (MNCN); 14-19: Paratipos, 1,9; 2,0; 1,7; 1,8; 1,8 y 1,9 mm (MNCN); 20: detalle de la abertura en el holotipo; 21: protoconcha; 22: microescultura de la protoconcha.*

to known that the species is still living. But it is very important to take action to protect the future of the species.

The taxon *Belgrandia occidentalis* Clessin, 1878 is also mentioned for Coimbra, and for this reason it surely applies to the same species and must be considered as a junior synonym. According to DANCE (1986) the Clessin collection in the Stuttgart Museum was totally destroyed in the Second World War.

Belgrandia silviae spec. nov. (Figs. 13-25, 70-73)

Belgrandia gibba Draparnaud, 1805. In NOBRE (1930: 206 [partim]).

Type material: Holotype (Fig. 13) plus 5 dry and 70 wet paratypes in MNCN (15.05/47571). Other paratypes in BMNH (10 sp), MHNS (80 sp), MHNP (50 sp), MNHN (10 sp), CHB (50 sp), CAO (160 sp), all live collected from the type locality, leg. A. de Oliveira, 12-February-2008 and 7-June-2008.
Type locality: In the spring of Alcabideque (NE4539), a small village 3 km east of Condeixa-a-Nova, 10 km to the south of Coimbra (and of Quinta das Lágrimas, type locality of *B. lusitanica*), province of Beira Litoral, Portugal. This spring is historically related to the old Roman town of Conímbriga, about 2 km to the west; the Romans built an aqueduct in order to carry the water into town. Later the Suevan people destroyed it. Presently, the water of this spring is carried to Ribeira de Bruscos and down the stream to the Ega River, a tributary of the Mondego River on its left margin.
Etmology: The specific name is dedicated to Sílvia Casteloa, the junior author's wife, for the companionship and constant help in the field.

Description: Shell (Figs. 13-19) oval-cylindrical, somewhat elongated, whorls very convex, with a deep suture.

Protoconch (Fig. 21) with about 1 whorl or a little more, the separation with the teleoconch being very difficult to see; diameter: nucleus about 130 ?m; first ? whorl, about 260 ?m. Microsculpture (Fig. 22) with a rough surface with minute depressions and numerous irregular lines.

Teleoconch with a little more than three whorls, which are very convex and show on their lower part an angulation which, on the last whorl, changes into a wide not very prominent spiral cord. The microsculpture (Fig. 23) is made of curved growth lines prosocline in the subsutural area and orthocline on the lower part.

Aperture almost circular, very irregular, continuous and undulating fine peristoma (Fig. 20). Externally, a little before the end of the spire, there is a prominent elevation which is placed on the spiral cord, not elongated axially and which forms in the inner part of the aperture an important depression. It is not present in juveniles.

Dimensions between 1.7 and 2.1 mm in height. The holotype is 2.0 mm high.

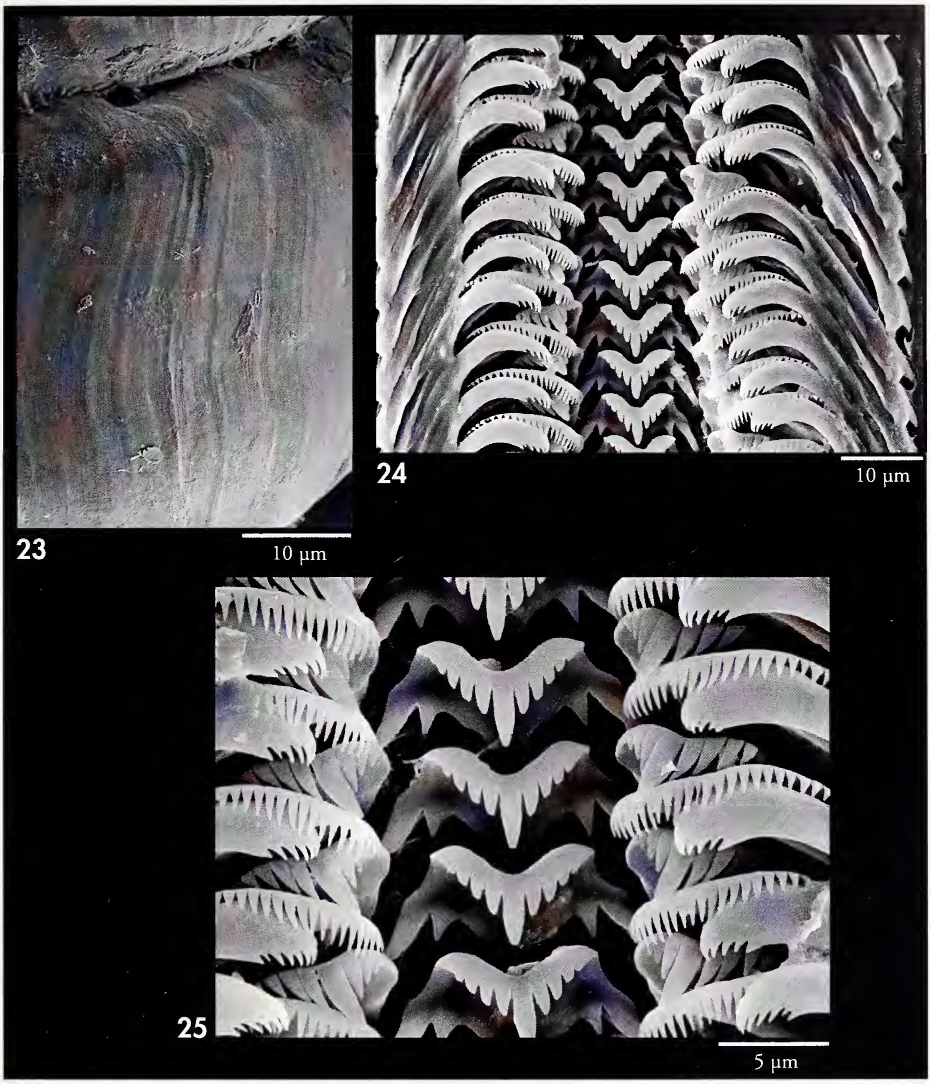
Animal dark, with tentacles dark with a white line in the middle; the dorsum of the head is dark with only white circular spaces around the eyes, which are black; the dark colour extends to the anterior part of the snout, which is white; behind the eyes there is a triangular space with cream or cream-yellowish colour; the sole of the foot is white. The penis (Figs. 70-73) is wide, sharp, with a narrow base, and one or two undulations on its internal border; a black longitudinal line is visible near the external border.

The radula (Figs. 24, 25) is typical of hydrobids, similar to the previous one but with less prominent lateral cusps in the rachidian tooth and also in the internal border of the lateral teeth.

Habitat: Under stones (limestone) lying on a coarse sandy bottom; always on surfaces devoid of all (macro) vegetation.

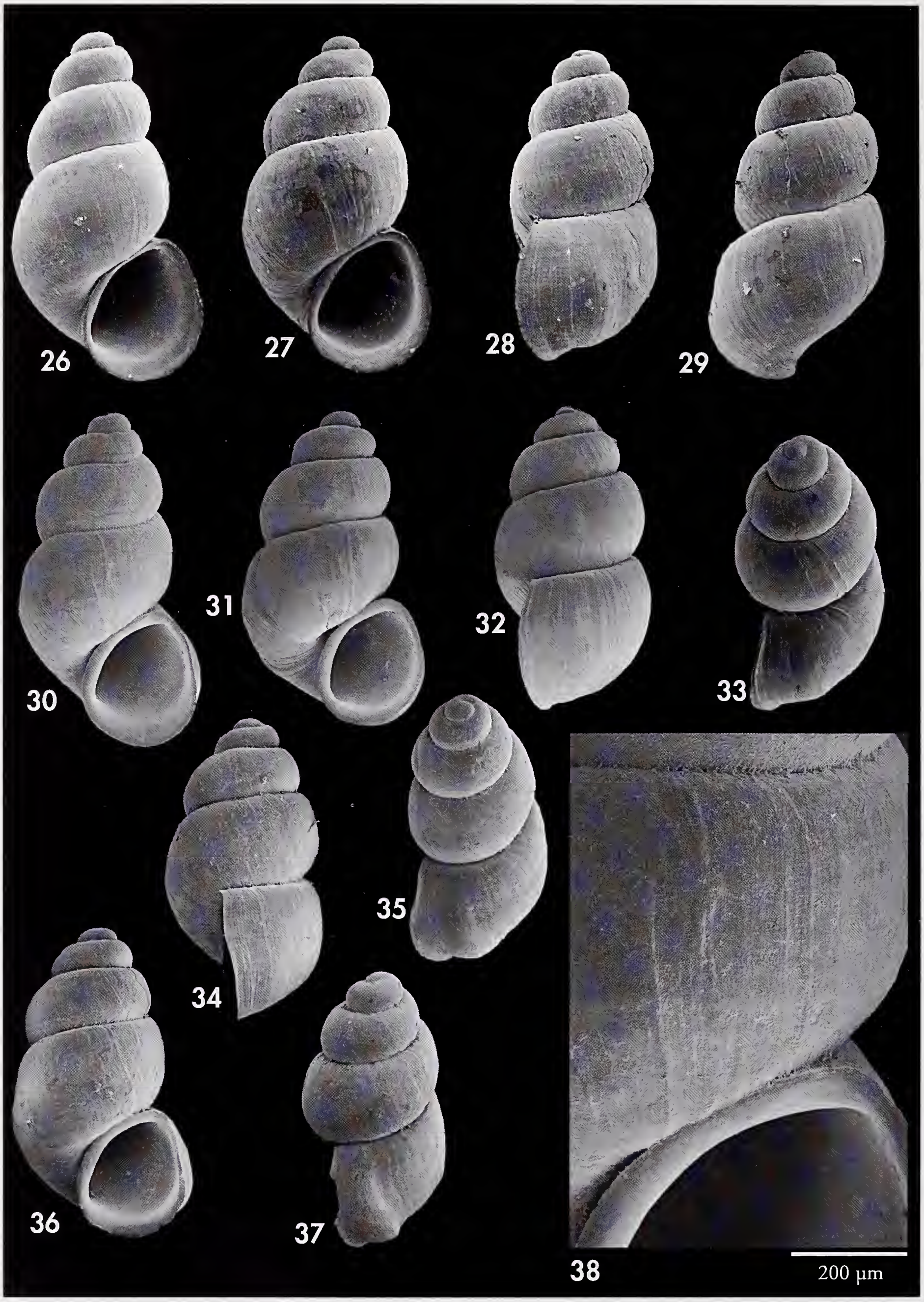
Distribution: Known from the type locality only (Fig. 78).

Remarks: The species had been mentioned by NOBRE (1930: 206) as *B. gibba* (Draparnaud).



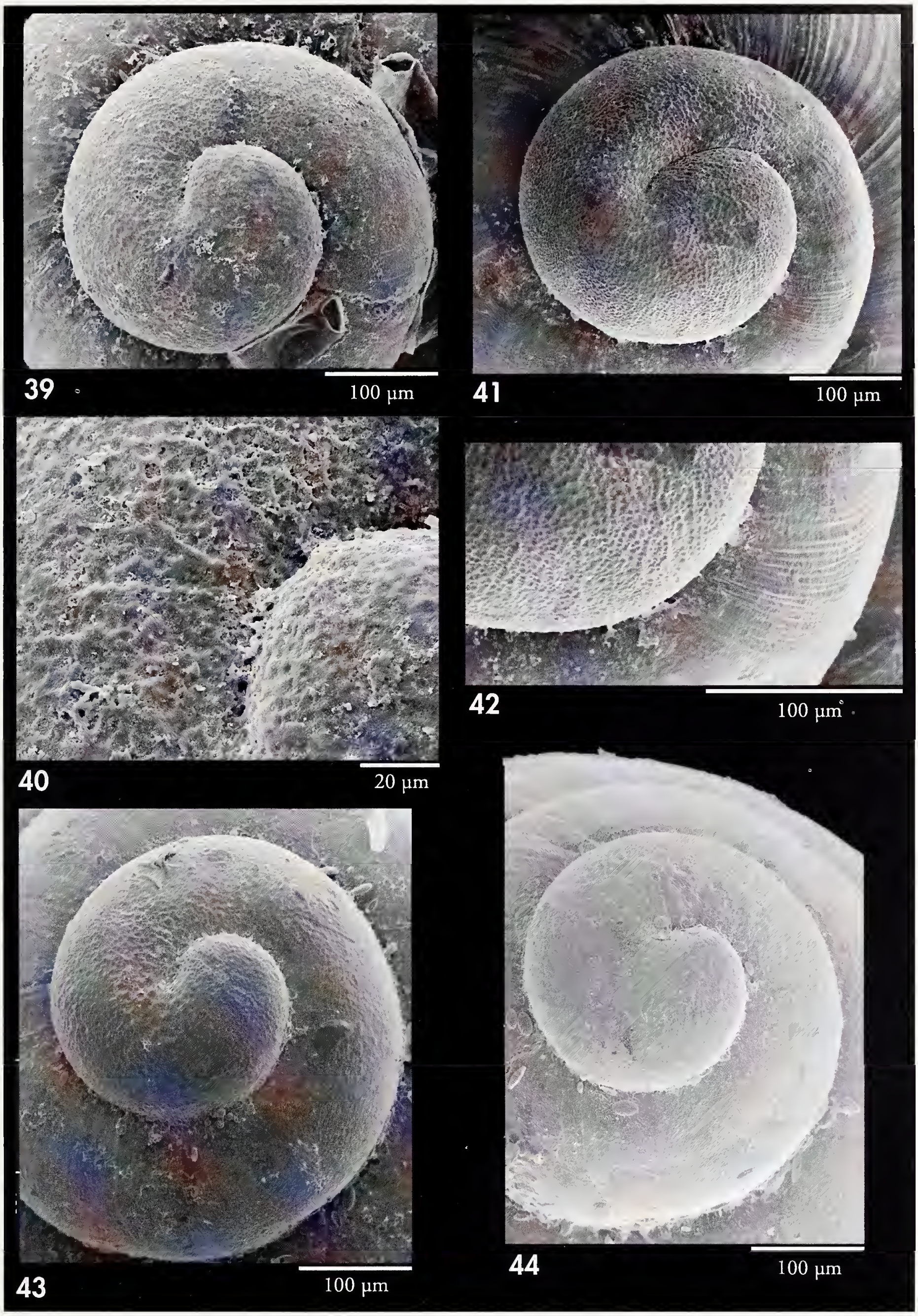
Figures 23-25. *Belgrandia silviae* spec. nov. 23: microsculpture of the teleoconch; 24, 25: radula; detail of the radula.
Figuras 23-25. Belgrandia silviae *spec. nov. 23: microescultura de la teleoconcha; 24, 25: rádula; detalle de la rádula.*

Its collecting was a surprise, being so close to the type locality of *Belgrandia lusitanica*. The prominence on the external part of the last whorl which is corresponded by a wide excavation within the aperture suggested to us that the species could employ it to retain an egg as other species of Hydrobids (for example, *Arganiella tartessae* Arconada and Ramos, 2007 and *Tarraconia rolani* Ramos, Arconada and Moreno, 2000 do this in the umbilicus). Anyway, it could be a similar strategy to that found in the family Coralliophillidae Chenu, 1859, in which the female has a similar place in the aperture to retain a capsule with



Figures 26-38. *Belgrandia heussi* C.R. Boettger, 1963. 26-30: shells, 1.9, 1.8. 1.7, 1.7 and 1.9 mm, from Alcobertas; 31-33: shells, 1.8, 1.7 and 1.7 mm, from Alviela; 34-36: shells, 1.6, 1.5 and 1.7 mm, from Lis; 37: shell, 1.9 mm, from Anços, 38: microsculpture of the teleoconch, shell from Alcobertas.

Figuras 26-38. Belgrandia heussi *C.R. Boettger, 1963. 26-30: conchas, 1,9; 1,8; 1,7; 1,7 y 1,9 mm, de Alcobertas; 31-33: conchas, 1,8; 1,7 y 1.7 mm, de Alviela; 34-36: conchas, 1,6; 1,5 y 1,7 mm, de Lis; 37: concha, 1,9 mm, de Anços, 38: microescultura de la teleoconcha, concha de Alcobertas.*



Figures 39-44. *Belgrandia heussi* C.R. Boettger, 1963. 39, 40: Protoconch and microsculpture, shell from Alcobertas; 41, 42: Protoconch and microsculpture, shell from Alviela; 43: Protoconch, shell from Lis. 44: Protoconch, shell from Anços.

Figuras 39-44. Belgrandia heussi *C.R. Boettger, 1963. 39, 40: Protoconcha y microescultura, concha de Alcobertas; 41, 42: Protoconcha y microescultura, concha de Alviela; 43: Protoconcha, concha de Lis. 44: Protoconcha, concha de Anços.*

eggs. But further collecting trying to make an immediate examination in order to confirm this point did not show any egg in this place. So we do not know the function of this prominence-excavation. When the animal is retracted, the operculum is placed deeper than this excavation.

Belgrandia lusitanica (Paladilhe, 1867) is geographically the closest species, but the morphological differences are very evident, being smaller in size, the prominence of the last whorl is smaller, axially disposed, without a corresponding internal excavation near the aperture, the protoconch is slightly smaller, the penis has a more evident small apendix.

Like *Belgrandia lusitanica* and *B. alcoaensis*, this species must be considered in high risk of extinction, due to its limited range, despite the fact that the type locality is nowadays preserved as an archaeological site.

Belgrandia heussi C. R. Boettger, 1963 (Figs. 26-48, 75, 76)

Belgrandia heussi C. R. Boettger, 1963. *Arch. Moll.*, 92: 40. [Type locality: Lis River, wich has its springs on the northern slope of Maciço Calcário Estremenho, and the mouth about 30 km south of the Mondego River, in the center of Portugal].

Type material: Holotype in SMF (167898).

Type locality: Rio Liz, Portugal.

Other material studied: Spring of the Anços River (NE3625), northern slope of Serra de Sicó, province of Beira Litoral, 210 sp, leg. A. de Oliveira, 3-April-2008 (MHNS: 100 sp; CAO: 110 sp). Springs of Abiul (NE3914), southern slope of Serra de Sicó, province of Beira Litoral, 20 sp, leg. S. Casteloa and A. de Oliveira, 7-June-2008 (MHNS: 10 sp; CAO: 10 sp). Spring of the Lis River (ND1992), northern slope of Maciço Calcário Estremenho, province of Beira Litoral, 240 sp, leg. A. de Oliveira, 15-February-2008 (MHNS: 100 sp; CAO: 140 sp). Spring of Alcobertas (ND0864), southern slope of Maciço Calcário Estremenho, province of Ribatejo, about 320 sp, leg. S. Casteloa and A. de Oliveira, 9-December-2007 (MHNS: 160 sp; CAO: 160 sp). Springs of the Alviela River (ND2466), southern slope of Maciço Calcário Estremenho, province of Ribatejo, 34 sp, leg. S. Casteloa and A. de Oliveira, 8-December-2007 (MHNS: 30 sp; CAO: 4 sp). Olho de Mira (ND2376), in a depression valley, south of Mira de Aire, central Maciço Calcário Estremenho, province of Estremadura, 4 sp, leg. E. Rolán, 19-May-2003.

Description: Shell (Figs. 26-37) conical, somewhat elongated, whorls convex, with marked suture, fragile.

Protoconch (Figs. 39-45) with about one whorl, difficult to see because the separation with the teleoconch is not usually visible; diameter is variable in the above mentioned populations: nucleus between 100 and 150 ?m; first ? whorl between 200 and 260 ?m. Microsculpture rough with minute depressions and irregular lines; in some shells from Lis (type locality) this sculpture is more attenuated (Figs. 44, 45).

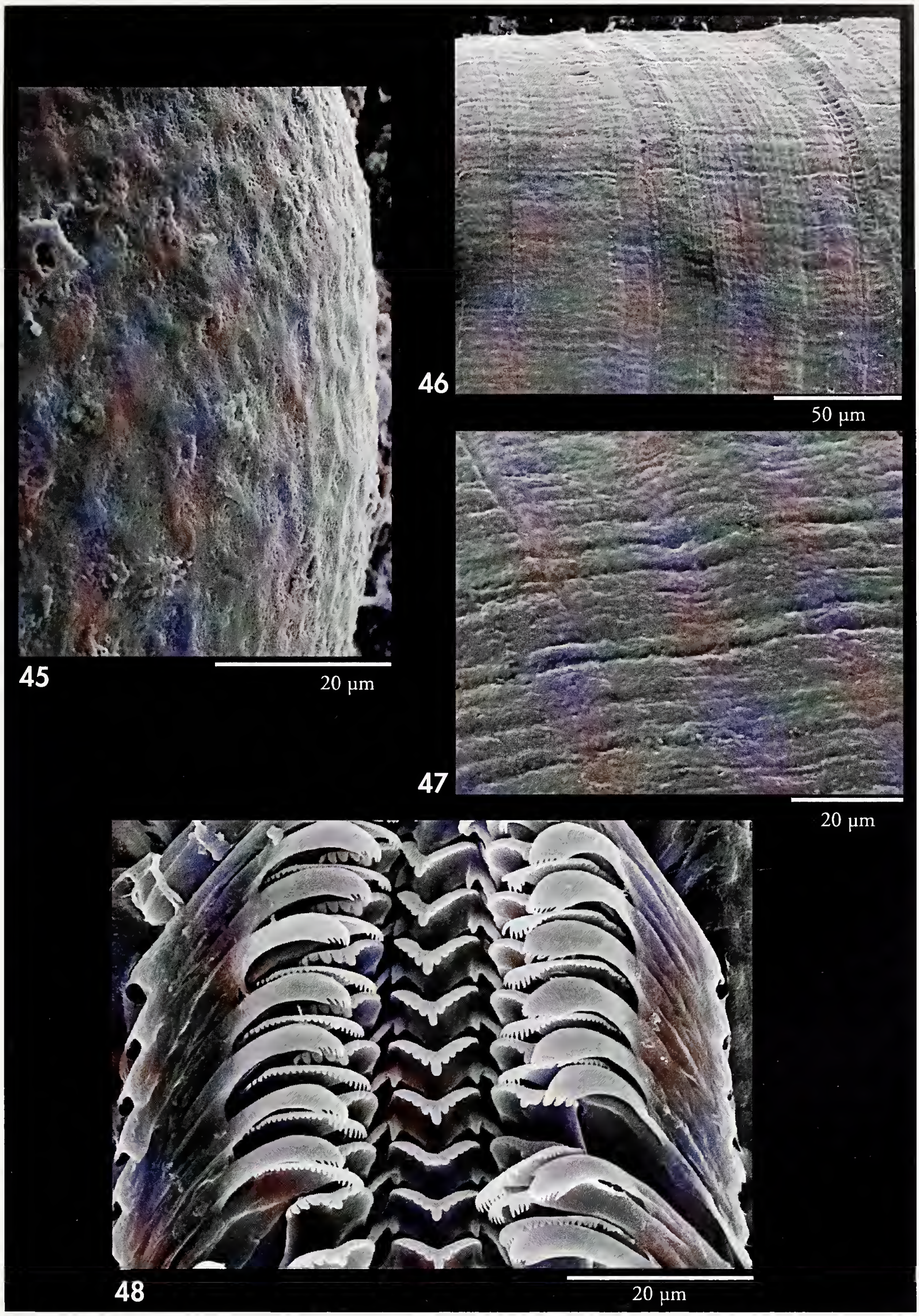
Teleoconch with about three convex whorls with a deep suture, the spiral microsculpture scarcely appreciable and only visible under high magnification (Figs. 46, 47) and having slightly prosocline growth lines.

Aperture slightly and regularly ovoid, and a continuous and fine peristoma. Externally, there is an axial thickening slightly away from the end of the spire, which does not correspond with any internal depression into the aperture.

Dimensions between 1.5 and 1.9 mm in height.

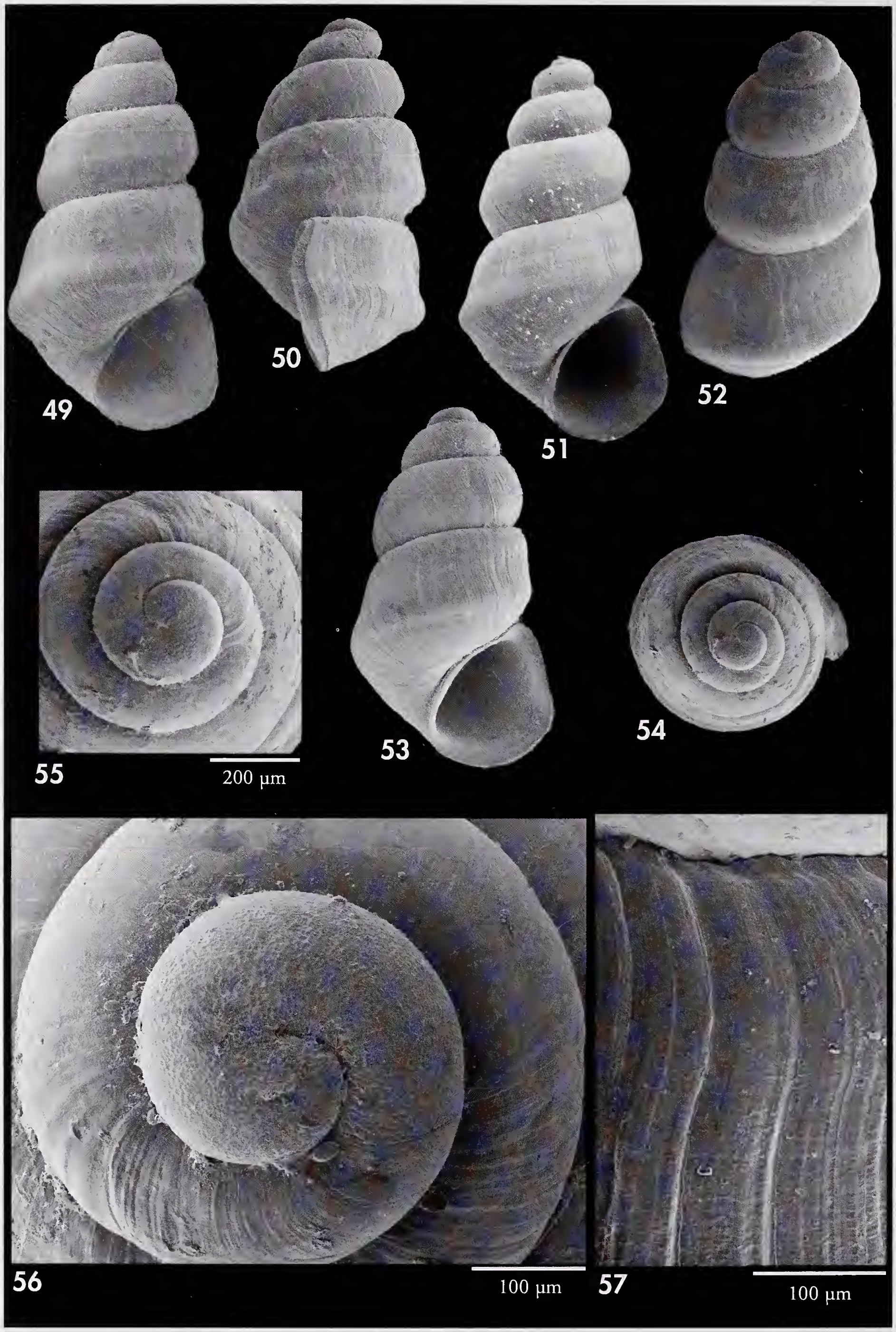
Animal dark only on the dorsum of the head and between the eyes, with tentacles dark with a white line in the middle; the penis (Figs. 75, 76) is folded on its base and sharp at the extreme, presenting two small prominences one to each side and sometimes a black line in the middle; the sole of the foot is white.

The radula (Fig. 48) is typical of hydrobids, similar to that of the previ-

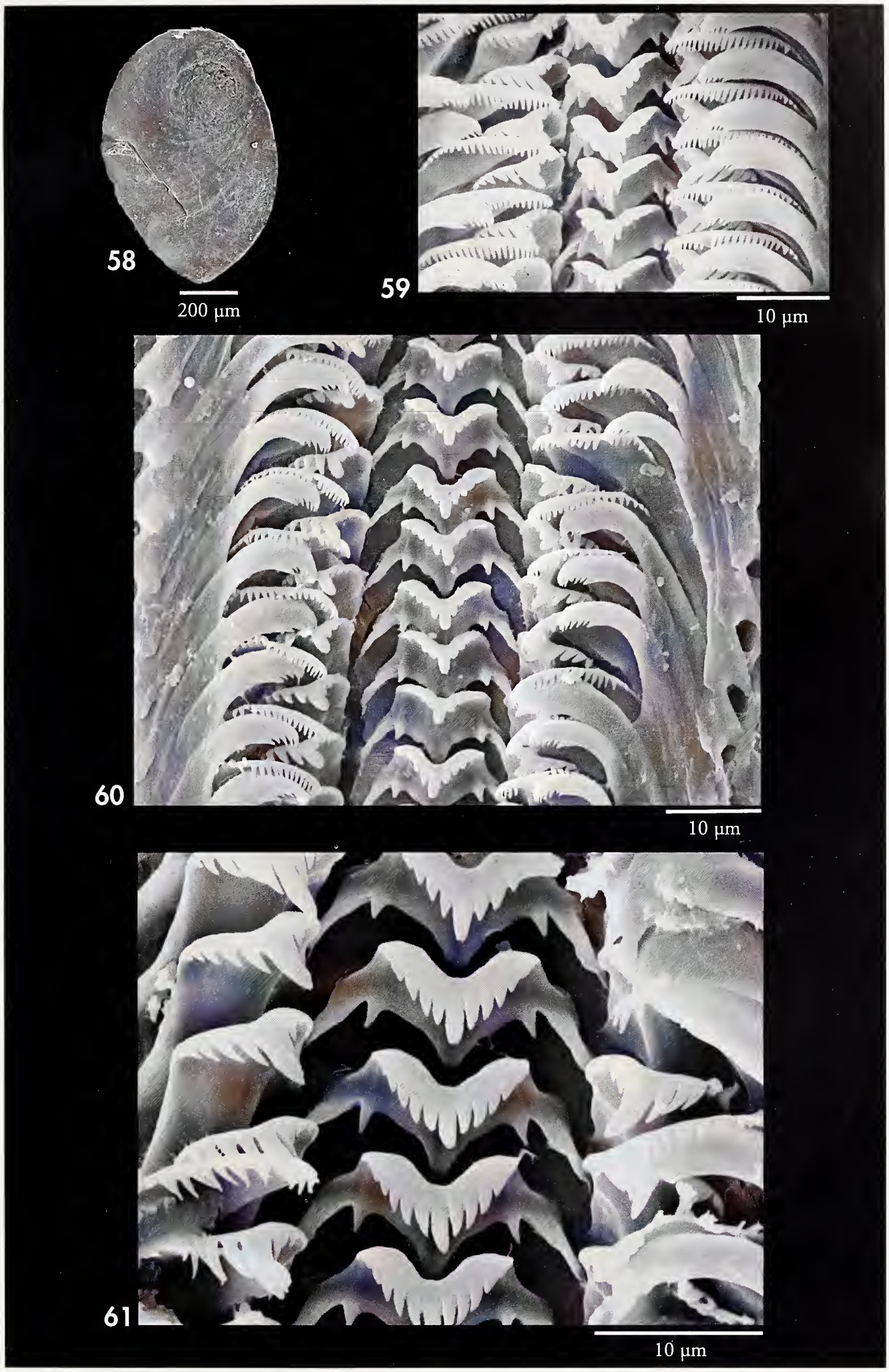


Figures 45-48. *Belgrandia heussi* C.R. Boettger, 1963. 45: microsculpture of the protoconch, shell from Lis; 46: microsculpture from a shell of Alcobertas; 47: microsculpture from a shell of Alviela; 48: radula, from a specimen of Alviela.

Figuras 45-48. Belgrandia heussi *C.R. Boettger, 1963. 45: microescultura de la protoconcha, concha de Lis; 46: microescultura de una concha de Alcobertas; 47: microescultura de una concha de Alviela; 48: rádula, de un ejemplar de Alviela.*



Figures 49-57. *Belgrandia alcoaensis* C.R. Boettger, 1963. 49-54: shells, 1.9, 1.7, 1.8, 1.7, 1.7 and 1.6 mm (MHNS); 55, 56: protoconchs; 57: microsculpture of the teleoconch.
Figuras 49-57. Belgrandia alcoaensis *C.R. Boettger, 1963. 49-54: conchas, 1,9; 1,7; 1,8; 1,7; 1,7 y 1,6 mm (MHNS); 55, 56: protoconchas; 57: microescultura de la teleoconcha.*



Figures 58-61. *Belgrandia alcoaensis* C. R. Boettger, 1963. 58: operculum; 59-61: radulae.
Figuras 58-61. Belgrandia alcoaensis *C. R. Boettger, 1963. 58: opérculo; 59-61: rádulas.*

ous species, with the cusps in the rachidian and lateral teeth a little shorter and less numerous.

Habitat: Under stones (limestone) lying on a coarse sandy bottom; always on surfaces devoid of all (macro) vegetation; in shady areas with running water. This species coexists with 5 other freshwater gastropods: *Theodoxus* cf. *fluviatilis* (LINNAEUS, 1758)[Anços, Alcobertas, Alviela], *Potamopyrgus antipodarum* (GRAY J. E., 1843)[Abiul, Lis, Alcobertas, Alviela], *Radix balthica* (LINNAEUS, 1758)[Anços, Abiul], *Ancylus fluviatilis* (MÜLLER O. F., 1774) [Abiul, Lis, Alviela] and *Physella acuta* (DRAPARNAUD, 1805) [Abiul, Alviela].

Distribution: Contrarily to the other three Portuguese species, only known from the type locality, *Belgrandia heussi* is present in several springs dispersed in three provinces of central western Portugal: Beira Litoral (Anços, Abiul, Lis), Estremadura (Olho de Mira) and Ribatejo (Alcobertas, Alviela) (Fig. 78).

Remarks: The material examined from several localities, is not enterely uniform, small differences existing between them. However, after the study of the morphology of the shells, protoconchs, and soft parts we could not find enough differences to consider them as different species.

Belgrandia lusitanica (Paladilhe, 1867) may be distinguished by its deeper suture and convex whorls; the peristome more undulating, the thickening of the external lip slightly stronger and close to the end of the spire; the suture is less marked on the last whorl. The penis has a smaller prominence on its right side; the radula shows a more marked cusp in the rachidian and internal border of the lateral teeth.

Belgrandia silviae spec. nov. is constantly larger, with deeper suture, the peristoma more undulating, the external prominence of the last whorl larger and not disposed axially, the growth lines curved and the aperture has a deep cave near the end of the spire.

Belgrandia alcoaensis C. R. Boettger, 1963 (Figs. 49-61, 74)

Belgrandia heussi alcoaensis C. R. Boettger, 1963. *Arch. Moll.*, 92: 42. [Type locality: Alcoa River, wich has its springs in the western slope of Maciço Calcário Estremenho, and after joining the Baça River, has its mouth about 35 km south of the Lis River, in the center of Portugal].

Type material: A paratype represented in HAASE (2000: fig. 3 H).
Type locality: Rio Alcoa, Portugal.
Other material studied: More than 1000 sp, leg. E. Rolán, 22-November-1991 (MHNS); 26 sp, leg. A. de Oliveira, 12-February-2008 (CAO). Both from the spring of the Alcoa River (ND0476), in the small village of Chiqueda de Cima, at 2 km east of Alcobaça, western slope of Maciço Calcário Estremenho, province of Estremadura, Portugal.

Description: Shell (Figs. 49-54) conical, somewhat elongated, whorls flat or scarcely convex, with marked suture, fragile.

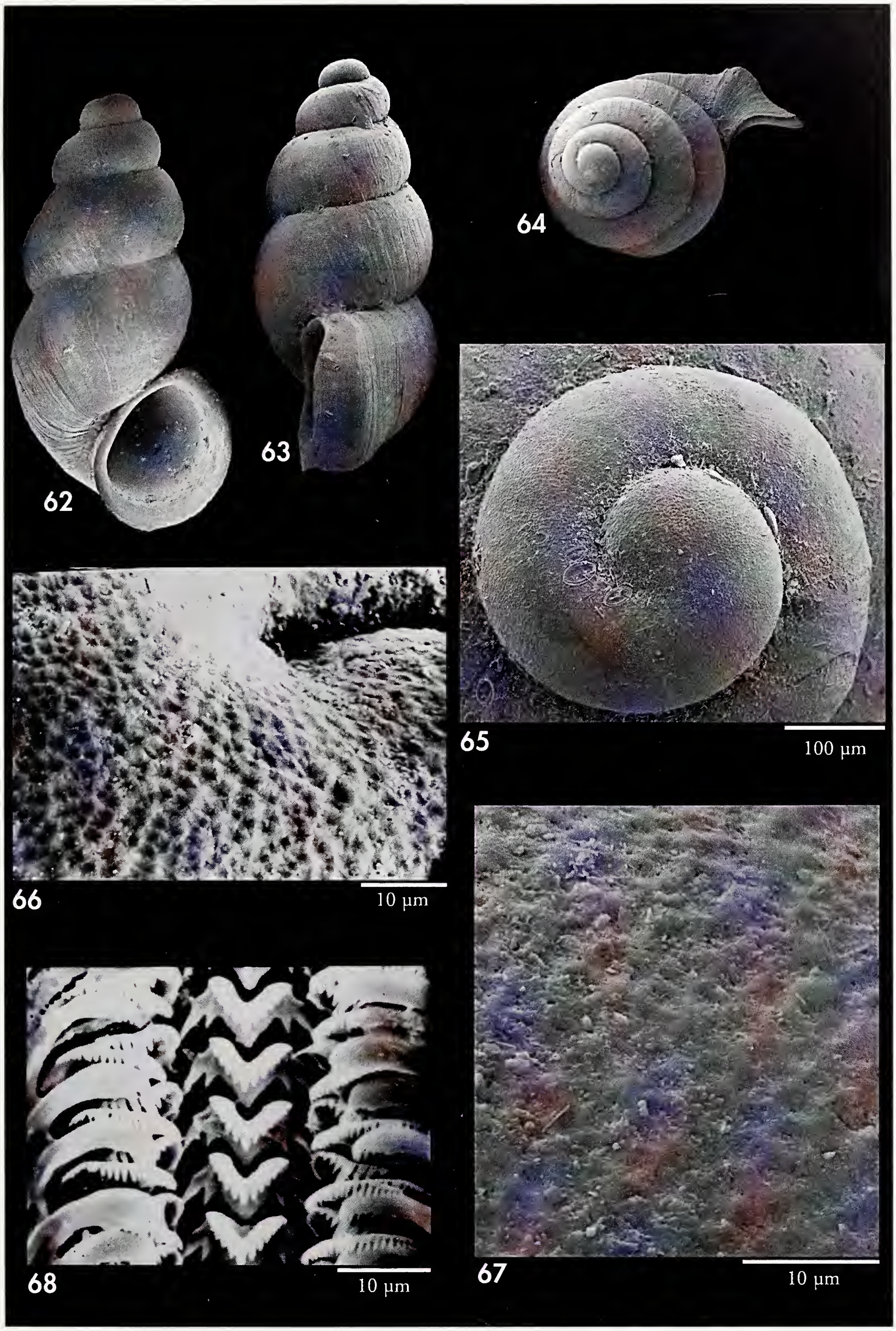
Protoconch (Figs. 55, 56) with a little less than one whorl, the separation with the teleoconch being usually visible; diameter about 300 ?m: nucleus about 125 ?m; first ? whorl, about 250 ?m. Spiral microsculpture with minute depressions.

Teleoconch with about three or three and a quarter whorls, with some irregular, very depressed and scarcely visible spiral striae and slightly prosocline growth lines (Fig. 57).

Aperture slightly ovoid, with a small deviation of the border of the external lip in the place where the spiral cords ends; there is a continuous and narrow peristoma. Externally, it is not possible to see any thickening near the external border.

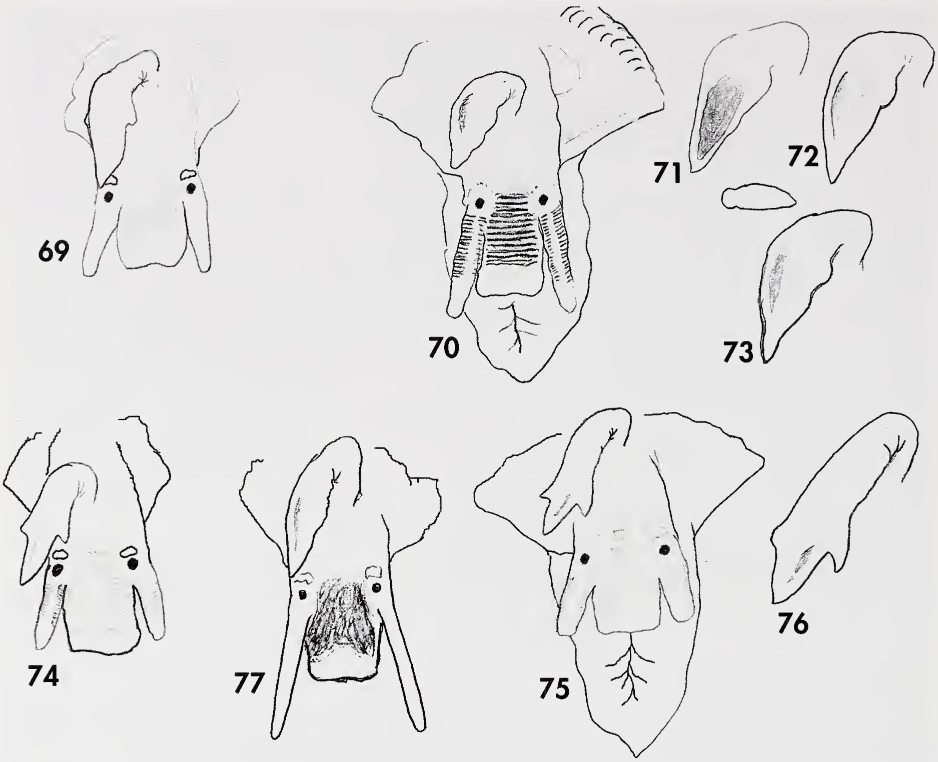
Dimensions between 1.6 and 1.9 mm in height.

Animal dark only on the dorsum of the head and between the eyes, with tentacles dark with a white line in the middle; the penis (Fig. 74) is folded on



Figures 62-68. *Belgrandia boscae* (Salvaña, 1887). 62-64: shells, 2.0, 1.9, 1.9 mm; 65: protoconch; 66, 67: microsculpture of the protoconch; 68: radula.

Figuras 62-68. Belgrandia boscae *(Salvaña, 1887). 62-64: conchas, 2,0; 1,9 y 1,9 mm; 65: protoconcha; 66, 67: microescultura de la protoconcha; 68: rádula.*



Figures 69-77. Soft parts and penis. 69: *Belgrandia lusitanica*, Quinta das Lágrimas; 70-73: *B. silviae* spec. nov., and several variations of the penis, Alcabideque; 74: *B. alcoaensis*, Alcoa River; 75, 76: *B. heussi*, and variation of the penis, from the spring of Lis River; 77: *B. boscae*, Fuente de la Corroba, Tarragona.
Figuras 69-77. Partes blandas y penes. 69: Belgrandia lusitanica, *Quinta das Lágrimas; 70-73:* B. silviae *spec. nov., con algunas variaciones del penis, Alcabideque; 74:* B. alcoaensis, *Río Alcoa; 75, 76:* B. heussi, *con variaciones del penis, del nacimiento del Río Lis; 77:* B. boscae, *Fuente de la Corroba, Tarragona.*

its base and sharp at the extreme, presenting two small prominences one to each side and sometimes a black line in the middle; the sole of the foot is white.

Operculum (Fig. 58) ovoid, translucent, with the nucleus a little lateral.

The radula (Figs. 59-61) is typical of hydrobids, similar to that of the previous species although the cusps in the rachidian and lateral teeth are a little shorter and less numerous.

Habitat: Under stones (limestone) lying on a coarse sandy bottom; always on surfaces devoid of (macro) vegetation. This species coexists with 4 other freshwater gastropods: *Theodoxus* cf. *fluviatilis* (LINNAEUS, 1758), *Potamopyrgus antipodarum* (GRAY J.E., 1843), *Ancylus fluviatilis* (MÜLLER O.F., 1774) and *Physella acuta* (DRAPARNAUD, 1805).

Distribution: Known from the type locality only (Fig. 78).

Remarks: *Belgrandia alcoaensis* was considered as a subspecies by Haase (2000: 185) after having only examined one shell (paratype). In the present work, we have examined many specimens and consider it very different from the other Portuguese species due to the almost flat whorls, especially the last one, the prominent spiral cord and the lack of any axial thickening.

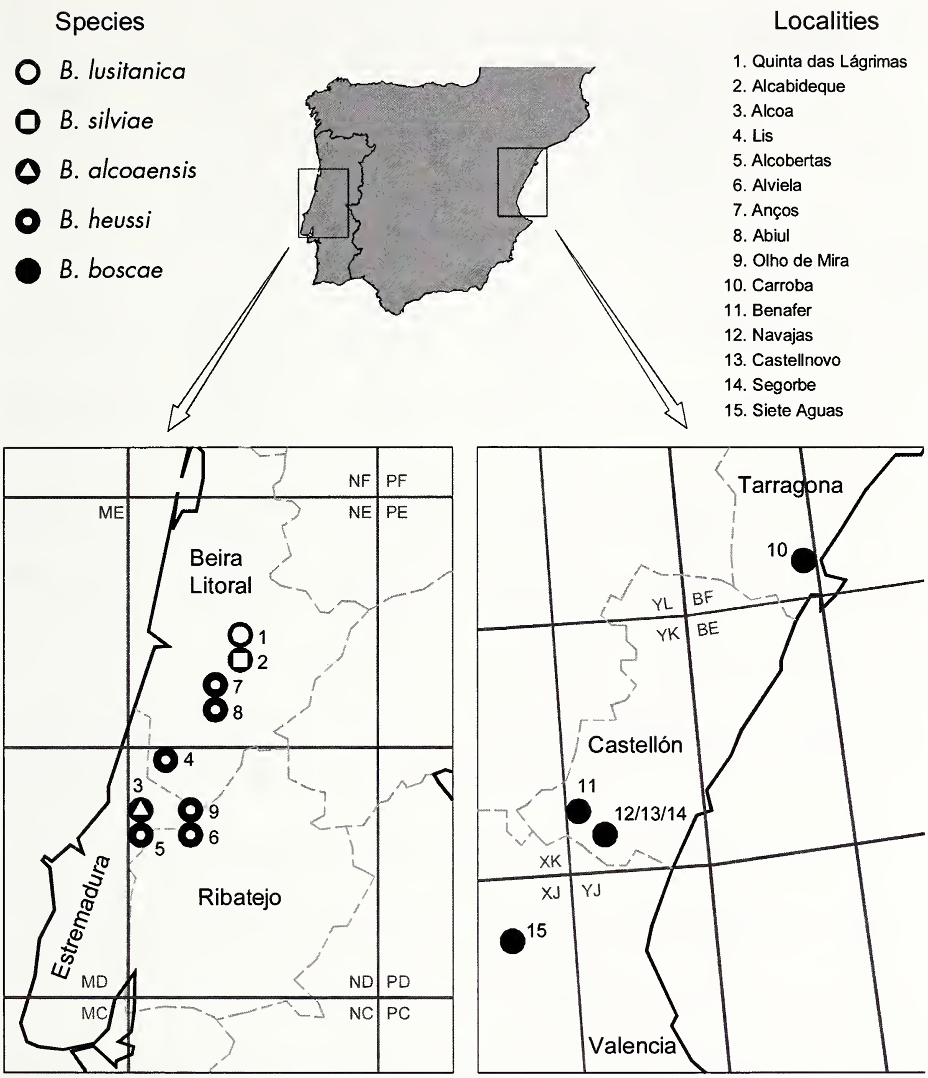


Figure 78. UTM 100 km squares distribution map of *Belgrandia* in Spain.
Figura 78. Mapa de distribución de Belgrandia *en España. Cuadrículas UTM de 100 km de lado.*

Belgrandia lusitanica, Belgrandia heussi and *Belgrandia silviae* spec. nov. may be distinguished by their deeper suture and more convex whorls, the last one not angulated, as well as the existence of a prominence or axial thickening on the external lip.

Like *Belgrandia lusitanica* and *Belgrandia silviae* spec. nov., this species must be considered in high risk of extinction, due to its limited range. This risk was recently increased by human intervention on the bed of the Alcoa River, from near its spring down the stream to the center of the village of Chiqueda de Cima. In the course of the last sampling in the site (February-2008), only a few specimens were observed.

Table I. Schematic differences of the characters of the species of *Belgrandia* in Iberian Peninsula.
Tabla I. Diferencias entre las especies de Belgrandia *de la península ibérica.*

	B. lusitanica	*B. heussi*	*B. alcoaensis*	*B. silviae*	*B. boscae*
Geographic distribution	Middle Portugal	Middle Portugal	Middle Portugal	Middle Portugal	Eastern Spain
Spiral cord	Sometimes slightly	Not apreciable	Very evident	Very evident	Not apreciable
Last whorl with peripheral angulation	Not apreciable	Not apreciable	Very evident	Slightly evident	Not apreciable
Last whorl	Convex	Convex	Convex	Almost flat	Convex
Axial external lip thickening	Axially disposed	Axially disposed slight	Not apreciable	Very prominent in the middle	Axially disposed
Columella	Somewhat separated	Somewhat separated	Adherent	Adherent	Somewhat separated
Excavation in the aperture	No	No	No	Very important	No
Suture	Strangulating slightly last whorl	Not strangulating	Not strangulating	Strangulating slightly last whorl	Not strangulating
Peristome	weakly undulating	weakly undulating	weakly undulating	Strongly undulating	weakly undulating
Diameter of protoconch nucleus	90 µm	100-150 µm	125 µm	130 µm	130 µm
Diameter of protoconch half whorl	240 µm	200-260 µm	250 µm	260 µm	275 µm
Height of the shell	1,4-1,9 mm	1,5-1,9 mm	1,6-1,9 mm	1,7-2,1 mm	1,6-2,2 mm

Belgrandia boscae (Salvaña, 1887) (Figs. 62-68, 77)

Hydrobia boscae Salvaña, 1887. *Crón. Cient., Barcelona,* 10: 141. [Type locality: In the springs of Gandía, Valencia, Spain]

Type material: After BOETERS (1988) and HAASE (2000), untraceable.
Type locality: Springs at Gandía, Valencia.
Material examined: YK11. 100 sp, road from Valencia to Teruel, in Navajas (Castellón) in front of the hotel Navas Altas (29-September-1990)(MHNS). YK02. 50 sp, Benafer, in the river near Fuente de los Nogales (Castellón) (29-September-1990)(MHNS). YK11. 50 sp, road from Segorbe to Artana, in Castellnovo, near the river (30-September-1990). YK11. 100 sp, Segorbe (Castellón), Fuente de los 50 caños (6-October-1990)(MHNS). XJ77. about 100 sp, Road from Requena to Valencia, in Siete Aguas (Fuente del Retiro, at 2 Kms) (8-October-1990) (MHNS). BF91. About 100 sp, Tarragona, Fuente de la Torre de la Carroba (3-July-1991) (MHNS).

Description: Shell (Figs. 62-64) oval-cylindrical, somewhat elongated, whorls convex, with deep suture.

Protoconch (Fig. 65) with about 1 whorl, the separation with the teleoconch being very difficult to see; diameter: nucleus about 130 ?m; first ? whorl, about 275 ?m. Microsculpture (Figs. 66, 67) with minute depressions, which under high magnification (Fig. 67) are seen to present depressed cavities.

Teleoconch with about three whorls, with only prosocline growth lines.

Aperture slightly ovoid, continuous and with a fine peristoma, a little undulating and everted. The contact area with the previous whorl is small. Externally, a little before the end of the spire, there is

an axial elongated thickening, very constant, only absent from juveniles.

Dimensions between 1.6 and 2.2 mm in height.

Animal dark, with tentacles with some pigment on the borders; the dorsum of the head is dark, only light on spaces around the eyes and the anterior part of the snout; behind the eyes there is a triangular space with cream or cream-yellowish colour; the penis (Fig. 77) is elongated, sharp-pointed, with an angle near its base, a little black on its anterior part, and sometimes with a small apendix on its left side, not always appreciable. The sole of the foot is white.

The radula (Fig. 68) is typical of hydrobids, with a central tooth with about 10 cusps, the central one scarcely more prominent; lateral teeth similar, with about ten cusps; the marginal ones are different, one with nearly 30 small and elongated cusps, and the other spoon-like with only few cusps.

Habitat: Under leaves and stones in very pure water in shady places.

Distribution: This species was found in several locations in the provinces of eastern Spain: Cuenca, Valencia, Castellón and Tarragona (see BOETERS, 1988).

Remarks: BOETERS (1988) presented this species under the name *Belgrandia* cf. *marginata* (Michaud, 1831) but indicating clear differences from the Spanish species of *Belgrandia* versus the topotypes of the true *B. marginata*. Therefore he states that perhaps the name for them could be *Belgrandia boscae*. We use this name because besides the morphological differences a large distance separates these populations from those of *B. marginata*.

There are quite clear differences from the Portuguese species, such as (Table I):

-*Belgrandia lusitanica* is the most similar, but the protoconch is smaller.

-*Belgrandia silviae* has a very important prominence at the end of the spire and an excavation inside the aperture, and also a spiral cord;

-*Belgrandia heussi* has a suture which is not so deep, the thickening of the last whorl less evident.

-*Belgrandia alcoaensis* usually lacks the thickening and has a well marked spiral cord.

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On the egg capsule of *Marginella glabella* (Linné, 1758)

Sobre la cápsula ovígera de *Marginella glabella* (Linné, 1758)

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ABSTRACT

The purse-shaped egg capsule of *Marginella glabella* (Linné, 1758) is described and pictured from a sample collected in Lanzarote, Canary Islands.
Due to the occurrence of the same kind of egg capsule in *M. goodalli* and to the occurrence of plano-convex egg capsules in all other *Marginella* species documented for this character, the shape of the egg capsule is proposed as a further feature characterizing the *M. glabella* species group.

RESUMEN

Se describe y se muestra por primera vez la cápsula ovígera de *Marginella glabella* (Linné, 1758), a partir de una muestra obtenida en Lanzarote, Islas Canarias.
Considerando la ocurrencia del mismo tipo de cápsula ovígera en *M. goodalli* y la ocurrencia de cápsulas plano-convexas en todas las demás especies de *Marginella* para las que existen datos de este carácter, se propone considerar la forma de la cápsula ovígera como un rasgo adicional para caracterizar el grupo de especies en torno a *M. glabella*.

INTRODUCTION

Knowledge of the morphology of the egg capsules of marginelliform gastropods was summarized and discussed by COOVERT (1986), through the presentation of egg capsules attributed to 16 different species.

Twelve of these species belong to the Marginellidae *sensu* Coovert and Coovert, 1995 (2 *Dentimargo* species, 3 *Glabella* species, 1 *Haloginella* species, 2 *Marginella* species, 2 *Prunum* species and 2 *Volvarina* species) and 4 belong to the Cystiscidae *sensu* Coovert and Coovert, 1995 (2 *Granulina* species and 2 *Persicula* species).

On the basis of these data, the Marginellidae species are said to have a plano-convex egg capsule, except for *Marginella goodalli* Sowerby, 1825 from off the Guinean zone, which has a purse-shaped egg capsule. The Cystiscidae species are said to also have a plano-convex egg capsule, except for *Persicula cornea* (Lamarck, 1822), from the Guinean zone too, which also has a purse-shaped egg capsule.

It is important to note that, in most cases, the specific attribution of the egg capsules recorded by COOVERT (1986) requires further confirmation, the laying of eggs not having been specifically observed and thus the larva being attributed with low certainty to a given species.

KNUDSEN (1950), who is the principal reference used by COOVERT (1986), himself admitted that the method of identification "is not absolutely reliable and possibly some incorrect identifications have been made". However, due to

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the fact that the attribution of purse-shaped egg capsules to *M. goodalli* and to *P. cornea* is proposed by Knudsen (1950) with credible arguments, the heterogeneity of egg capsule types within both Marginellidae and Cystiscidae must be provisionally accepted, at least between genera and possibly within some of them.

More recent records of plano-convex egg capsules of Marginellidae species were made by Gofas and Fernandes (1988) concerning *Marginella spinacia* Gofas and Fernandes, 1988 from São Tomé, by Fernandes and Rolán (1991) concerning *M. eveleighi* Tomlin and Shackleford, 1913 from Principe, and by Penchaszadeh and Rincon (1996) concerning *Prunum prunum* (Gmelin, 1791) from Venezuela. The identification of the egg capsules of these two *Marginella* species was made with a high degree of certainty on the basis of the morphologic characters of the larvae, whereas the identification was made with absolute certainty for the *Prunum* species through direct observation of the clutch raised in an aquarium.

The problem raised by the heterogeneity of the egg capsule types within each of the two marginelliform families Marginellidae and Cystiscidae was not tackled by Coovert (1986), by Coovert and Coovert (1995) or by subsequent authors, despite the fact that any intergrades between the two capsule types under discussion is unknown.

The discovery of a purse-shaped egg capsule attributable to *Marginella glabella* (Linné, 1758), type species of the genus *Marginella* Lamarck, 1799, is presented herein. This new record allows us to reassess the issue of the heterogeneity of egg capsule types in the genus *Marginella*, together with the apparent synapomorphies characterizing the *M. glabella* species group.

MATERIAL AND METHODS

The data concerning the clutch of *M. glabella* comes from material and observations communicated by José Hernández.

J. Hernández found a purse-shaped egg-capsule (Figs. 1-2) fixed under a stone at 3-5 m off Playa Quemada, situated on the southeastern coast of Lanzarote, eastern Canary Islands. The egg capsule contained one larva close to hatching. This larva was removed from the capsule by opening the suture line defined along the cutting edge of the "purse" (Fig. 3) and it was photographed out of the capsule (Fig. 4). The shell of this larva was compared with the protoconch of live collected adult specimens of *M. glabella* (Fig. 5) sampled in the vicinity by Francisco Sicilia and Javier Lopez-Vicente.

The terms "plano-convex" and "purse-shaped" egg capsule are used by preference, respectively, to the terms "lenticular or lens-shaped capsule" and "lenticular capsule with a flat base" used by Coovert (1986). This preference is due to the inadequately descriptive meaning of "lenticular" applied to the cases considered, and to the ambiguity introduced by the use of the same word for defining two different types of capsule morphology. As a matter of fact, the two types of egg capsules examined differ not only in the way they are attached to the substrate (via a basal membrane extending beyond the capsule walls in the case of the plano-convex type, versus via a more or less produced stalk in the case of the purse-shaped type), but also in the way the capsules are torn open at the hatching stage [along a suture line surrounding the hemispherical upper side of the capsule quite close to the base in the plano-convex type (see in Coovert, 1986), versus escape from an "exit hole" at the top of the capsule (see in Knudsen, 1950: 121) or along the cutting edge of the lateral borders (this work)].

RESULTS

The attribution of the purse-shaped egg capsule found off Playa Quemada to the species *M. glabella* is based on the morphology of the larval shell removed from the capsule.

The outline of this capsule looks quite like that of a chicken egg horizontally oriented and put on a ventrally fixed short stem. The capsule is laterally compressed, smooth, hyalinous light honey-amber. The

Figures 1-5. *Marginella glabella*, Playa Quemada, Lanzarote. 1,2: egg capsule, view from both sides, width= 7 mm; 3: hatching of the larva; 4: larval shell with animal retracted; 5: adult shell, length= 26 mm.

Figuras 1-5. Marginella glabella, *Playa Quemada, Lanzarote. 1-2: cápsula ovígera, vistas desde ambos lados, ancho= 7 mm; 3: eclosión de la larva; 4: concha larvaria con el animal retraído; 5: concha adulta, longitud= 26 mm.*

total height of this capsule is 5 mm, the height of the "purse" is 4 mm, its width is 7 mm, and the stalk length is 1 mm. The shell of the larva perfectly matches by its shape, its consistency, its colour and its size (1,3 mm at the base line of its upper quarter, 2 mm at its wider diameter) the protoconch (width: 1,3 mm) of the *M. glabella* adult specimens found in the vicinity (compare Figures 4 and 5). No other gastropod species from this geographical area show a similar protoconch.

DISCUSSION

M. glabella is shown to have an egg capsule of the purse-shaped type, like the congeneric species *M. goodalli*. The egg capsule described by KNUDSEN (1950) for *M. goodalli* is quite different from that of *M. glabella*, due to its taller, more produced, subcylindrical outline, but both species can be said to have the same type of egg capsule, deeply different from the plano-convex egg capsules

of the supposedly congeneric *M. cleryi*, *M. spinacia* and *M. eveleighi*, and of the closely related *Glabella adansoni* (Kiener, 1834), *Dentimargo aureocincta* (Stearns, 1872) and *D. cairoma* (Brookes, 1924).

Other characters shared by *M. glabella* and *M. goodalli* are rather inflated non-sculptured orange to reddish shells with white marks or spots, and orange animals with white spots or dots. On the basis of personal observations of live specimens in Senegal, the species proposed to belong to the *M. glabella* species group together with *M. glabella* and *M. goodalli* are *M. aurantia* (Lamarck, 1822), *M. desjardini* (Marche-Marchad, 1957), *M. sebastiani* (Marche-Marchad and Rosso, 1979) and *M. lamarcki* (Boyer, 2004). The specific validity of other taxa commonly linked to this group (like *M. irrorata* Menke, 1828 and *M. pseudosebastiani* Mattavelli, 2001) remains dubious and requires further investigation.

The possession of the same type of egg capsule is considered here as a further synapomorphy defining the *M. glabella* species group as very distinct from the other *Marginella*, *Glabella* and *Dentimargo* species groups.

A noticeable plasticity is often observed at the individual level in egg capsules of marine gastropods, and a noticeable disparity in the details of the capsule morphology is often observed between species belonging to the same genus. For instance, Rolán and Raybaudi Massilia (1995) showed the high variability of the egg capsules in *Conus mediterraneus* and Moreno and Templado (1995) demonstrated that the sibling species *Nassarius cuvieri* and *N. unifasciatus* from the Lusitanian Province have very distinct egg capsules despite the similarity of their shell characters. However the type of egg capsule seems to be homogeneous in monophyletic groups : purse-shaped type in *C. mediterraneus* and cushion-shaped type in the *N. cuvieri*/*N. unifasciatus* series.

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Diversity and spatial distribution of the gastropod fauna (Mollusca: Gastropoda) on subtidal sedimentary substrata of the Ensenada de Baiona (Galicia, NW Iberian Peninsula)

Diversidad y distribución espacial de la fauna de gasterópodos (Mollusca: Gastropoda) de los sustratos sedimentarios submareales de la Ensenada de Baiona (Galicia, NW Península Ibérica)

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ABSTRACT

Gastropods (Mollusca: Gastropoda) are an important component of soft-bottom faunas in temperate latitudes. The diversity and distribution of gastropod fauna on sedimentary substrata at the Ensenada de Baiona (Galicia, NW Iberian Peninsula) was studied by means of quantitative sampling. The total number of species was similar to that found in other Galician "rias" dominated by sandy sediments and greater than in other "rias". whose sediments are mostly muddy. Gastropod assemblages in gravelly and sandy bottoms of the inlet were, in general, more diverse than those in muddy sediments.

The distribution and composition of gastropod assemblages in the Ensenada de Baiona is related to the granulometric composition and median grain size of the sediment, which are, in turn, influenced by the intrinsic hydrodynamic conditions of the inlet. These patterns of gastropod distribution are similar to those previously reported for other benthic taxa in the same area.

RESUMEN

Los moluscos gasterópodos (Mollusca: Gastropoda) constituyen un importante componente de la fauna de fondos blandos en latitudes templadas. La diversidad y distribución de la fauna de gasterópodos de los sustratos sedimentarios de la ensenada de Baiona (Galicia, NW península Ibérica) fue estudiada por medio de muestras cuantitativas. El número total de especies encontrado en la ensenada fue similar al registrado en otras rías de Galicia caracterizadas por presentar sedimentos principalmente arenosos, y mayor que en las rías dominadas por sedimentos fangosos. La distribución y composición de las comunidades de gasterópodos en la ensenada de Baiona está relacionada con la composición granulométrica y la mediana del tamaño de grano del sedimento, que están determinadas a su vez por las particulares condiciones hidrodinámicas de la zona. Estos patrones de distribución son similares a los registrados para otros grupos zoológicos en esta misma ensenada.

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INTRODUCTION

Benthic faunas inhabiting subtidal soft-bottoms are influenced by a number of interacting abiotic and biotic factors, such as granulometry, hydrodynamism, organic matter content, predation and competition (see, for example, WILDISH, 1977; GRAY, 1981; WILSON, 1991). Spatio-temporal fluctuations of those factors determine, in many cases, the patterns of distribution and composition of benthic assemblages (STUBBLEFIELD, PERMENTER AND SWIFT, 1977). The characterization of those patterns is of paramount importance to evaluate the relative role of natural perturbances and of that derived from anthropogenic activities (UNDERWOOD, 1992).

The Galician rias (NW Spain) have highly diverse benthic faunas due, in part, to the great variety of habitats and sediments present there (p.e. LÓPEZ-JAMAR, 1981; MORA, 1982; TRONCOSO AND URGORRI, 1993). The seashore around the rias is highly populated and therefore subjected to many perturbations such as those due to the culture of bivalves on rafts, construction of harbour facilities, industrial activities and disposal of sewages (LÓPEZ-JAMAR, 1978; LÓPEZ-JAMAR, GONZÁLEZ AND MEJUTO, 1986; CASTELLANOS, HERNÁNDEZ-VEGA AND JUNOY, 2003). The effects of these perturbations mostly translate into organic enrichment and changes in sedimentary composition (LÓPEZ-JAMAR, 1978; LÓPEZ-JAMAR AND MEJUTO, 1985), which, in turn, affect the composition of benthic assemblages and the stability of the populations of many species (LÓPEZ-JAMAR *ET AL.*, 1986).

There are still many areas of the Galician rías whose benthic fauna is little known, such as the Ensenada de Baiona, an inlet located to the south of the Ría de Vigo. Mollusca are an important component of soft-bottom benthic faunas (TRONCOSO AND URGORRI, 1993; GUERRA-GARCÍA AND GARCÍA-GÓMEZ, 2004) and their study might be also useful to check the state of benthic assemblages (BOENING, 1999). Lists of species of the molluscan fauna present in the Ensenada de Baiona were provided by MACANDREW (1849), HIDALGO (1886), ROLÁN (1983) and ROLÁN, OTERO AND ROLÁN-ÁLVAREZ (1989); MOREIRA, QUINTAS AND TRONCOSO (2005) studied the distribution of subtidal molluscan assemblages as a whole. Nevertheless, the composition and distribution of subtidal gastropod assemblages as such have not been described from this area yet. In fact, the description of gastropod assemblages has often been neglected in papers dealing with soft-bottom mollusc faunas. In general, more attention is paid to bivalves which are, on many occasions, more abundant than gastropods in sedimentary environments (DENADAI AND AMARAL, 1999; RUEDA, FERNÁNDEZ-CASADO, SALAS AND GOFAS, 2001; MOREIRA *ET AL.*, 2005). In this paper, we present a list of gastropod species found during the sampling programmes developed by the group of Adaptaciones de Animales Marinos from the University of Vigo between 1995 and 1997 in the Ensenada de Baiona. The description of gastropod assemblages in the soft bottoms of the inlet is also provided and relates them to sediment characteristics and other environmental features. This work is part of a baseline study on the benthic assemblages from subtidal sediments of the Ensenada de Baiona; temporal dynamics of gastropod assemblages will be described elsewhere.

MATERIAL AND METHODS

Study area

The Ensenada de Baiona is located on the southern margin of the mouth of the Ría de Vigo, between 42° 07′ N - 42° 09′ N and 08° 51′ W - 08° 49 ′W (Fig. 1). Salinity ranges from 32‰ in winter to 35‰ in summer in the outer area, and from 28‰ to 35‰ in the harbour area. The northern and eastern margins of the inlet are bordered by sandy beaches, while the western outer margin is exposed to oceanic swell and winter winds (ALEJO, AUSTIN, FRANCÉS AND VILAS, 1999); the harbour jetty provides

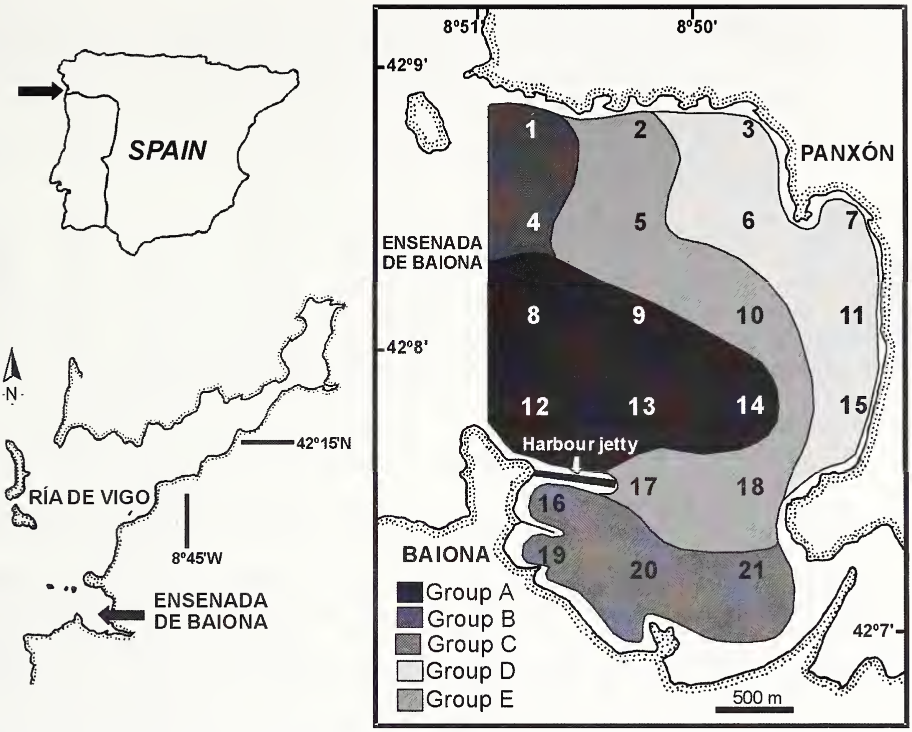

Figure 1. Location of the Ensenada de Baiona and sampling sites. Sites are grouped according to Cluster and Simprof analysis.
Figura 1. Localización de la ensenada de Baiona y de los puntos de muestreo. Los puntos de muestreo se agrupan en función de los resultados de los análisis Cluster y Simprof.

shelter to the southern area around the harbour of Baiona. Most of its soft bottoms are sandy; the distribution of sediments follows a gradient in grain size (ALEJO *ET AL.*, 1999; MOREIRA *ET AL.*, 2005). Sediments of the outer mouth of the inlet are composed of gravel and coarse sand; in the central area the dominant fractions are medium and fine sand, while sediments in northern and eastern margins are constituted mostly by fine and very fine sand (MOREIRA *ET AL.*, 2005). Sediments in the harbour area range from sandy mud to mud with percentages of silt/clay of up to 90%.

Sampling

In order to study diversity and distribution of gastropods, quantitative sampling was done at the Ensenada de Baiona in December 1995 at 21 subtidal sandy sites (Table I). Four of these sites were further studied with a monthly periodicity between February 1996 and February 1997 (results will be published in a forthcoming paper). Five replicates were taken at each site using a van Veen grab with a sampling area of 0.056 m^2 thus covering a total area of 0.28 m^2 on each site. Samples were sieved through a 0.5 mm mesh and fixed in 10% buffered formalin for later sorting and identification of the fauna. An additional sediment sample was taken at each site to determine granulometric composition, median grain size (Q_{50}), sorting coefficient (S_o), carbonates (%) and total organic matter (TOM, %). The following sedimentary fractions were considered: gravel (GR, > 2 mm), very coarse sand (VCS, 2-1 mm), coarse sand (CS, 1-0.5 mm), medium sand (MS, 0.5-0.25 mm), fine sand (FS, 0.25-0.125 mm), very fine sand (VFS,

TABLE I. COORDINATES AND PHYSICAL CHARACTERISTICS OF THE SAMPLING SITES IN THE ENSENADA DE BAIONA. Q_{50}, MEDIAN GRAIN SIZE; $CO_3^=$, CARBONATE CONTENT; TOM, TOTAL ORGANIC MATTER CONTENT.
Tabla I. Coordenadas y características físicas de los puntos de muestreo en la ensenada de Baiona. Q_{50}, *mediana del tamaño de grano;* $CO_3^=$, *contenido en carbonatos; TOM, materia orgánica total.*

Site	Position (N)	Position (W)	Depth (m)	Gravel (%)	Sand (%)	Silt/Clay (%)	Q_{50} (mm)	Sedimentary type	Sorting	$CO_3^=$ (%)	TOM (%)
1	42°08'50"N	08°50'52"W	7	94.23	5.74	0.03	5.00	Gravel	Moderate	24.26	1.48
2	42°08'50"N	08°50'15"W	7	3.52	89.96	6.52	0.13	Muddy sand	Moderate	32.39	1.91
3	42°08'50"N	08°49'44"W	4	0.01	87.19	12.80	0.09	Muddy sand	Moderately well sorted	29.67	2.27
4	42°08'30"N	08°50'52"W	12	-	-	-	-	-	-	-	-
5	42°08'30"N	08°50'15"W	11	0.15	88.40	11.45	0.09	Muddy sand	Moderately well sorted	34.37	1.70
6	42°08'30"N	08°49'44"W	7	0.09	90.66	9.25	0.09	Muddy sand	Moderately well sorted	37.59	2.10
7	42°08'30"N	08°49'13"W	3	0.04	96.44	3.53	0.15	Fine sand	Moderate	48.33	2.05
8	42°08'10"N	08°50'52"W	12	10.29	88.40	1.31	0.83	Coarse sand	Moderate	68.94	1.48
9	42°08'10"N	08°50'15"W	10	1.24	95.70	3.06	0.35	Medium sand	Moderate	82.67	2.28
10	42°08'10"N	08°49'44"W	8	5.84	88.94	5.22	0.14	Muddy sand	Moderate	49.13	2.20
11	42°08'10"N	08°49'13"W	3	0.18	84.28	15.54	0.10	Muddy sand	Moderately well sorted	44.20	2.58
12	42°07'50"N	08°50'52"W	9	8.27	91.71	0.03	0.90	Coarse sand	Moderate	61.31	1.32
13	42°07'50"N	08°50'15"W	8	0.44	96.47	3.09	0.34	Medium sand	Moderate	79.68	2.07
14	42°07'50"N	08°49'44"W	9	1.14	95.70	3.16	0.31	Medium sand	Moderate	80.35	2.18
15	42°07'50"N	08°49'13"W	4	0.03	95.83	4.14	0.14	Fine sand	Moderate	45.00	2.32
16	42°07'30"N	08°50'45"W	4	0.04	9.85	90.11	0.02	Mud	Poor	5.81	12.05
17	42°07'30"N	08°50'15"W	7	9.63	84.18	6.19	0.23	Muddy sand	Moderate	72.91	3.18
18	42°07'30"N	08°49'44"W	8	2.11	94.08	3.82	0.23	Fine sand	Moderate	75.33	2.48
19	42°07'19"N	08°50'45"W	2	2.53	22.95	74.52	0.02	Mud	Poor	7.11	8.45
20	42°07'10"N	08°50'15"W	3	0.17	21.66	78.17	0.02	Mud	Poor	6.85	7.28
21	42°07'10"N	08°49'44"W	3	0.19	50.61	49.20	0.06	Sandy mud	Poor	4.36	2.82

0.125-0.063 mm), and silt/clay (< 0.063 mm). Sedimentary types were characterized according to JUNOY AND VIÉITEZ (1989). Carbonate content (%) was estimated by treating of the sample with hydrochloric acid. The total organic matter content (TOM, %) was estimated from the weight loss on combustion at 450°C for 4 hours.

Data analyses

The total abundance (N), number of species (S), the Shannon-Wiener diversity index (H', log_2) and Pielou's evenness (J) were calculated for each site. Gastropod assemblages were determined through non-parametric multivariate techniques (FIELD, CLARKE AND WARWICK, 1982), using the Primer 6 software package (CLARKE AND GORLEY, 2006). Similarities between samples were determined based on the abundance data of species. These data were transformed prior to the analyses by applying square root in order to downweigh the contribution of the most abundant species. Data were previously averaged across the five replicates for each site thus obtaining a centroid. From the simi-

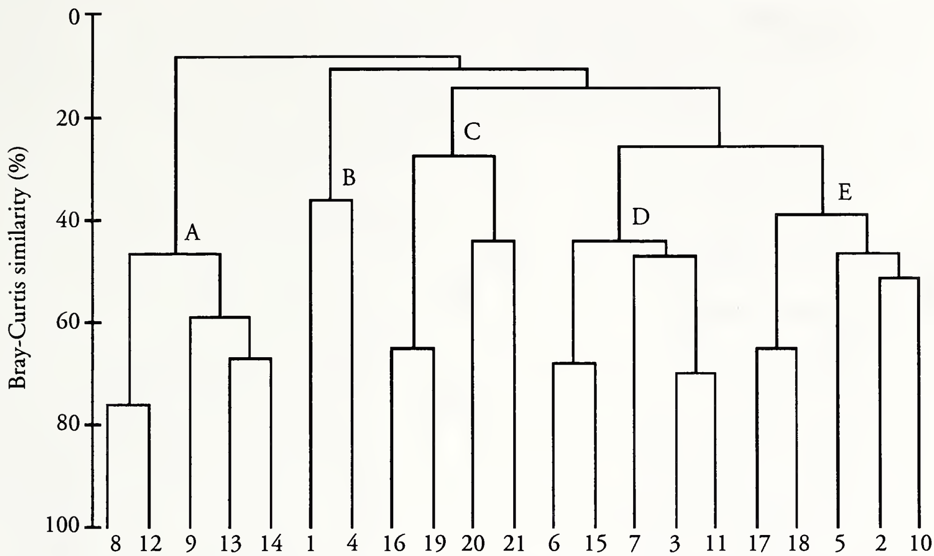

Figure 2. Dendrogram of classification of sampling sites according to values of Bray-Curtis similarity index calculated on data of species abundance. Groups of sites (A-E) were determined according to Simprof results.

Figura 2. Dendrograma de clasificación de los puntos de muestreo en función del índice de similitud de Bray-Curtis calculado según los datos de abundancia de las especies. Las agrupaciones de los puntos de muestreo (A-E) fueron determinadas según el análisis Simprof.

larity matrix, a classification of the sampling sites was done by Cluster analysis based on the group-average sorting algorithm, obtaining a dendrogram. Clusters of sites determined as statistically significant by profile test Simprof ($p < 0.05$) were considered as having a similar gastropod composition. Non-metric multidimensional scaling (nMDS) was used to produce a visual representation of the ordination of centroids. Cluster analysis was also done to check for species affinities (inverse analysis) based on the abundance data of the numerically dominant species, i.e. those whose abundance is ≥1% of the total abundance.

The possible relationship between gastropod fauna and the measured environmental variables was explored using the Bio-Env procedure (Primer). All variables expressed in percentages were previously transformed by log (x+1). The following variables were considered in these analyses: TOM, granulometric fractions (GR, CS, MS, FS, VFS), median grain size, sorting coefficient, skewness, kurtosis, temperature and depth, while carbonates, VCS, silt/clay and pH were excluded due to their high correlation with other variables ($r>0.9$, $p<0.01$). Sites 1 and 4 were discarded for Bio-Env analysis because of their stony nature, which could make interpretation of the analyses difficult, and insufficient sediment sample from site 4.

RESULTS

Cartography of subtidal sediments in 1995 yielded a total of 1631 specimens belonging to 47 species (Table II). 14 additional species were found during the temporal study (from February 1996 to February 1997), bringing the total number of species up to 61. The richest family in number of species was Pyramidellidae (10) and the best represented in number of individuals was Caecidae (23.8% of total abundance; Table III). About half of the

Table II. Systematic list of all gastropod species found in the Ensenada de Baiona during the cartography (December 1995) and the temporal study (*, February 1996-February 1997).
Tabla II. Lista sistemática de todas las especies de gasterópodos encontradas en la ensenada de Baiona durante el estudio cartográfico (Diciembre 1995) y temporal (, Febrero 1996-Febrero 1997).*

Subclass PROSOBRANCHIA

Family Patellidae Rafinesque, 1815
Ansates pellucida (Linneo, 1758)

Family Acmaeidae Carpenter, 1857
Tectura virginea (Müller, 1776)

Family Fissurellidae Fleming, 1822
Emarginula rosea Bell, 1824
Puncturella noachina (Linneo, 1771)

Family Trochidae Rafinesque, 1815
Gibbula cineraria (Linneo, 1758)
Gibbula magus (Linneo, 1758)
Gibbula tumida (Montagu, 1803)
Jujubinus exasperatus (Pennant, 1777)

Family Phasianellidae Swainson, 1840
Tricolia pullus (Linneo, 1758)

Family Cerithiidae Fleming, 1822
Bittium reticulatum (da Costa, 1778)

Family Turritellidae Woodward, 1851
Turritella communis Risso, 1826

Family Eulimidae H. Adams & A. Adams, 1853
Melanella alba (da Costa, 1778)

Family Rissoidae Gray, 1847
Alvania beani (Hanley *in* Thorpe, 1844)
Manzonia crassa (Kanmacher, 1798)
Onoba semicostata (Montagu, 1803)
**Pusillina inconspicua* (Alder, 1844)
**Rissoa guerinii* Récluz, 1843
Rissoa lilacina Récluz, 1843
Rissoa parva (da Costa, 1778)

Family Caecidae Gray, 1850
**Caecum glabrum* (Montagu, 1803)
Caecum trachea (Montagu, 1803)

Family Calyptraeidae Blainville, 1824
Calyptraea chinensis (Linneo, 1758)
**Crepidula fornicata* (Linneo, 1758)

Family Naticidae Gray, 1840
Euspira pulchella (Risso, 1826)

Family Muricidae Rafinesque, 1815
Ocenebra erinaceus (Linneo, 1758)

Family Nassariidae Iredale, 1916
Nassarius incrassatus (Ström, 1768)
Nassarius pygmaeus (Lamarck, 1822)
Nassarius reticulatus (Linneo, 1758)

Family Conidae Fleming, 1822
Bela nebula (Montagu, 1803)
Mangelia attenuata (Montagu, 1803)
Mangelia coarctata (Forbes, 1840)

Family Omalogyridae Sars, 1878
Omalogyra atomus (Philippi, 1841)

Family Pyramidellidae Gray, 1840
Chrysallida decussata (Montagu, 1803)
Chrysallida fenestrata (Jeffreys, 1848)
Chrysallida indistincta (Montagu, 1808)
Chrysallida terebellum (Philippi, 1844)
Eulimella acicula (Philippi, 1836)
Odostomia conoidea (Brocchi, 1814)
Odostomia eulimoides Hanley, 1844
Odostomia scalaris MacGillivray 1843
Odostomia unidentata (Montagu, 1803)
**Ondina diaphana* (Jeffreys, 1848)
**Turbonilla lactea* (Linneo, 1758)
Turbonilla pusilla (Philippi, 1844)

Family Murchisonellidae Casey, 1905
Ebala nitidissima (Montagu, 1803)

Subclass OPISTHOBRANCHIA

Family Acteonidae d'Orbigny, 1835
Acteon tornatilis (Linneo, 1758)

Family Diaphanidae Odhner, 1814
**Diaphana minuta* Brown, 1827

Family Retusidae Thiele, 1925
Cylichnina umbilicata (Montagu, 1803)
Retusa mammillata (Phillipi, 1836)
**Retusa obtusa* (Montagu, 1803)
Retusa truncatula (Bruguière, 1792)
Volvulella acuminata (Bruguière, 1792)

Family Philinidae Gray, 1850
Philine aperta (Linneo, 1767)
Philine punctata (Adams, 1800)
Philine scabra (Müller, 1784)

Family Cylichnidae Lovèn, 1846
Cylichna cylindracea (Pennant, 1777)

Family Limapontiidae Gray, 1847
**Limapontia depressa* Alder & Hancock, 1862

Family Akeridae Odhner, 1922
**Akera bullata* Müller, 1776

Family Dorididae Rafinesque, 1815
Doris verrucosa Linneo, 1758

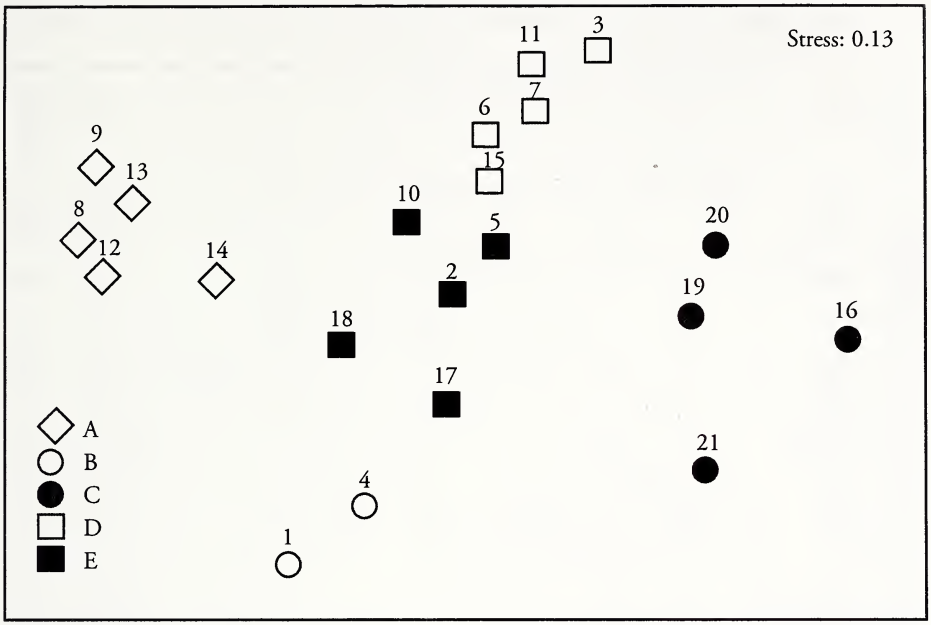

Figure 3. nMDS ordination of sampling sites showing groups determined by Cluster and Simprof analysis.
Figura 3. Ordenación nMDS de los puntos de muestreo indicando los grupos determinados por los análisis Cluster y Simprof.

species found were represented by less than 10 individuals each. The best represented taxa in the inlet (present in at least 50% of the sampling sites) were the nassariid, *Nassarius reticulatus* (Linneo, 1758), and the naticid, *Euspira pulchella* (Risso, 1826). The total number of species per site ranged from 1-2 (sites 3, 11 and 16; Table IV) to 17-19 (sites 4, 17-18). Maximal total gastropod densities were found at sites 18, 4 and 21 (> 700 ind. m^{-2}) and the lowest ones at sites 3, 11 and 16 (< 40 ind. m^{-2}). The highest values of diversity (H') were recorded at sites 17 and 18 (H' > 3.00 bits); those sites also showed a high evenness (J > 0.70). Diversity was smaller than 1.0 bits in sites 3, 6, 11, 16 and 20; the lowest values of evenness were found at sites 3 and 20 (J < 0.40).

Gastropod assemblages

The dendrogram obtained by Cluster analysis showed five major groups of sites (Fig. 2): group A (sites 8, 9, 12, 13, 14; coarse and medium sand), group B (st. 1 and 4, gravel), group C (st. 16, 19, 20 and 21; sandy mud and mud), group D (st. 3, 6, 7, 11 and 15; fine sand sites at the margins of the inlet) and E (st. 2, 5, 10, 17 and 18; fine sand sites at the centre of the inlet). These groups were found to have an internal structure according to the Simprof test ($p < 0.05$). The graphic representation of the nMDS analysis showed an ordination of sites which agrees with dendrogram groups and distribution of sedimentary types (Fig. 3). Group A was located in the outer and central parts of the inlet and was characterized by *Caecum trachea* (Montagu, 1803), *Cylichnina umbilicata* (Montagu, 1803) and *Philine* spp. Group B was composed of sites located in the northern outer area and was numerically dominated by *Tectura virginea* (Müller, 1776), *Calyptraea chinensis* (Linneo, 1758) and *Gibbula* spp. Sites of group C were situated around the

Table III. Abundance of dominant species (abundance ≥1% of total abundance) in each sampling site expressed as individuals per m^2.

Sampling site	**8**	**9**	**12**	**13**	**14**	**1**	**4**	**16**	**19**	**20**	**21**
Dendrogram group	**A**	**A**	**A**	**A**	**A**	**B**	**B**	**C**	**C**	**C**	**C**
Species											
Caecum trachea	160.7	482.1	78.6	210.7	410.7	-	3.6	-	-	-	-
Bittium reticulatum	-	-	-	-	-	-	-	17.9	17.9	235.7	628.6
Cylichnina umbilicata	-	35.7	-	110.7	135.7	-	-	-	-	-	-
Nassarius reticulatus	-	-	-	-	7.1	-	17.9	-	3.6	17.9	3.6
Tectura virginea	-	-	-	-	-	39.3	317.9	-	-	-	-
Gibbula tumida	-	-	3.6	-	25.0	75.0	89.3	-	3.6	-	-
Retusa truncatula	-	-	-	-	-	-	-	3.6	7.1	-	135.7
Gibbula cineraria	-	-	-	-	-	-	92.9	-	-	-	-
Calyptraea chinensis	-	-	-	-	-	-	96.4	-	-	-	-
Chrysallida terebellum	-	-	-	-	-	-	-	-	-	-	50.0
Philine punctata	-	107.1	-	-	7.1	-	-	-	-	-	-
Euspira pulchella	14.3	-	7.1	7.1	10.7	7.1	7.1	-	-	-	-
Philine aperta	32.1	3.6	28.6	3.6	10.7	-	-	-	-	-	-
Bela nebula	-	-	-	-	-	-	-	-	-	-	-
Cylichna cylindracea	-	-	-	-	-	-	-	-	-	-	-
Nassarius pygmaeus	-	-	-	-	-	-	-	-	-	-	-

harbour of Baiona; the group was characterized by a small total number of species (10); *Bittium reticulatum* (da Costa, 1778) was the dominant species followed by *Retusa truncatula* (Bruguière, 1792). Group D was distributed along the margins of the inlet; this group was the poorest in terms of number of species and individuals. Group E was composed of fine sand sites located in the central area and was characterized by the highest total number of species (29); *N. reticulatus* and *C. umbilicata* were the numerically dominant species.

According to Simper analysis, dissimilarities between groups A (coarser sandy sediments) and B (gravel) were determined by *C. trachea, T. virginea, Gibbula tumida* (Montagu, 1803), *C. umbilicata* and *Philine aperta* (Linneo, 1767) (up to 50% of total dissimilarity); the species that most contributed to dissimilarities between A and D (fine-sand sites at the margins of the inlet) were *C. trachea, C. umbilicata* and *N. reticulatus* (up to 55% of dissimilarity) and between A and E (fine-sand sites at the central area of the inlet) were the same aforementioned species together with *P. aperta* and *Cylichna cylindracea* (Pennant, 1777) (up to 50% of dissimilarity). Most of the total dissimilarity (up to 50%) between groups D and E were due to *C. umbilicata, N. reticulatus, C. cylindracea, R. truncatula, Nassarius pygmaeus* (Lamarck, 1822), *E. pulchella* and *Bela nebula* (Montagu, 1803); those species were more abundant in group E than in group D. The species *B. reticulatum* and *N. reticulatus* were responsible for up to 50% dissimilarity between groups C (mud sites) and D while *B. reticulatum, reticulatus C. umbilicata, E. pulchella* and *C. cylindracea* were the species most contributing to total dissimilarity between groups C and E (up to 50%).

Species affinities

The dendrogram obtained by inverse analysis done on the abundance data of the species considered as dominant in each site showed four main groups at a 40% similarity level (Fig. 4).

Tabla III. Abundancia de las especies dominantes (abundancia ≥1% de la abundancia total) en cada punto de muestreo expresada como individuos por m².

Sampling site	3	6	7	11	15	2	5	10	17	18
Dendrogram group	D	D	D	D	D	E	E	E	E	E
Species										
Caecum trachea	-	-	-	-	-	-	-	-	3.6	35.7
Bittium reticulatum	-	-	-	-	-	7.1	-	-	-	-
Cylichnina umbilicata	-	-	-	3.6	-	110.7	-	17.9	-	239.3
Nassarius reticulatus	10.7	28.6	21.4	17.9	32.1	53.6	25.0	42.9	128.6	196.4
Tectura virginea	-	-	-	-	-	-	-	-	-	3.6
Gibbula tumida	-	-	-	-	-	-	-	-	-	-
Retusa truncatula	-	-	-	-	-	7.1	7.1	7.1	14.3	7.1
Gibbula cineraria	-	-	-	-	-	-	-	3.6	14.3	46.4
Calyptraea chinensis	-	-	-	-	-	-	-	-	10.7	28.6
Chrysallida terebellum	-	-	-	-	-	25.0	-	-	25.0	17.9
Philine punctata	-	-	-	-	-	-	-	-	-	3.6
Euspira pulchella	-	3.6	-	-	3.6	7.1	14.3	3.6	10.7	17.9
Philine aperta	-	-	-	-	-	-	-	-	-	-
Bela nebula	-	3.6	-	-	7.1	10.7	-	3.6	25.0	25.0
Cylichna cylindracea	-	-	-	-	-	3.6	7.1	3.6	21.4	39.3
Nassarius pygmaeus	-	-	-	-	-	7.1	10.7	-	28.6	25.0

Group 1 included species mostly found at sites dominated by coarser sandy fractions (site group A), i.e. *C. trachea, Philine aperta* and *P. punctata* (Adams, 1800). Group 2 was composed of species whose higher abundance was found in gravelly sites (site group B); those species were *T. virginea, C. chinensis, Gibbula cineraria* (Linneo, 1758) and *G. tumida.* Group 3 was composed of *B. reticulatum, R. truncatula* and *Chrysallida terebellum* (Philippi, 1844); those species were present in fine-sand and mud sites but were more abundant in the latter sediments. Group 4 comprised the largest group of species, which were mainly found in site groups D and E; group 4 included species that were widespread across fine-sand sites such as *N. reticulatus, E. pulchella* and *C. umbilicata.*

Gastropod fauna and environmental variables

The Bio-Env procedure showed that a number of combinations of the selected environmental variables had high correlations with abundance data of gastropod species through the Spearman rank correlation coefficient (pw > 0.70 in many cases). The best combinations of variables were those composed of organic matter, sorting coefficient, coarse sand, medium sand, very fine sand and skewness. The median grain size was the variable that alone showed the highest correlation (pw = 0.57), followed by very fine sand (pw = 0.51). The nMDS ordination of sites with superimposed values of the mentioned variables showed that sites appeared distributed from left to right following decreasing values of median grain size; sites with greater content in very fine sand were located in the central part of the graphic representation (Fig. 5).

DISCUSSION

Quantitative sampling showed that the soft-bottom gastropod fauna from the Ensenada de Baiona is rich and diverse in number of species (61) and its

Table IV. Total number of species per 0.28 m^2 (S), total abundance per m^2 (N), Shannon-Wiener's diversity index (H', log_2) and Pielou's evenness (J) for each sampling site. The group to which each sampling site belongs according to multivariate analyses is also indicated.
Tabla IV. Número total de especies por 0.28 m^2 (S), abundancia total por m^2 (N), índice de diversidad de Shannon-Wiener (H', log_2) y equidad de Pielou (J) para cada punto de muestreo. Se indica el grupo al que pertenece cada punto de muestreo de acuerdo con los análisis multivariante.

Sampling site	Group	S	N	H'(log_2)	J'
8	A	4	211	1.07	0.54
9	A	7	643	1.17	0.42
12	A	7	132	1.80	0.64
13	A	5	364	1.46	0.63
14	A	13	639	1.75	0.47
1	B	9	154	2.16	0.68
4	B	17	750	2.75	0.67
16	C	2	21	0.65	0.65
19	C	5	36	1.96	0.84
20	C	3	257	0.47	0.30
21	C	7	861	1.30	0.46
3	D	1	11	0.00	0.00
6	D	3	36	0.92	0.58
7	D	4	36	1.57	0.79
11	D	2	21	0.65	0.65
15	D	5	71	1.98	0.85
2	E	11	246	2.51	0.72
5	E	6	68	2.33	0.90
10	E	11	104	2.74	0.79
17	E	18	436	3.46	0.83
18	E	19	729	3.03	0.71

composition is similar to those reported from other areas in the northern Iberian Peninsula (e. g. Martínez and Adarraga, 2003; Troncoso, Moreira and Urgorri, 2005; Lourido, Gestoso and Troncoso, 2006). In addition, the total number of species is within the same range as those recorded in studies done in other Galician rias which covered similar types of sediments. For example, Troncoso, Parapar and Urgorri (1993) and Garmendia, Sánchez-Mata and mora (1998) reported, respectively, 62 and 66 species from the Ría de Ares-Betanzos, and Lourido *et al.* (2006) found 60 species at the Ría de Aldán. Although the aforementioned rias are much larger than the Ensenada de Baiona they share with the latter a similar gastropod diversity. Those rias are characterized by having a large variety of sedimentary types, which are usually distributed following a gradient in grain size, i.e. coarser sediments appear at the mouth of the rias and finer sediments towards the internal areas (Troncoso & Urgorri, 1993; Lourido *et al.*, 2006). In general, this sedimentary diversity usually translates into more diverse benthic faunas than those which appear in areas where sediments are more homogeneous. Thus, many of the southern rias (Rías Baixas) which are dominated by muddy sediments with high contents of organic matter have poorer gastropod assemblages. For instance, López-Jamar (1981) reported 7 species of gastropods from the Ría de Muros and 8 species from the Ría de Pontevedra (López-Jamar, 1978) while

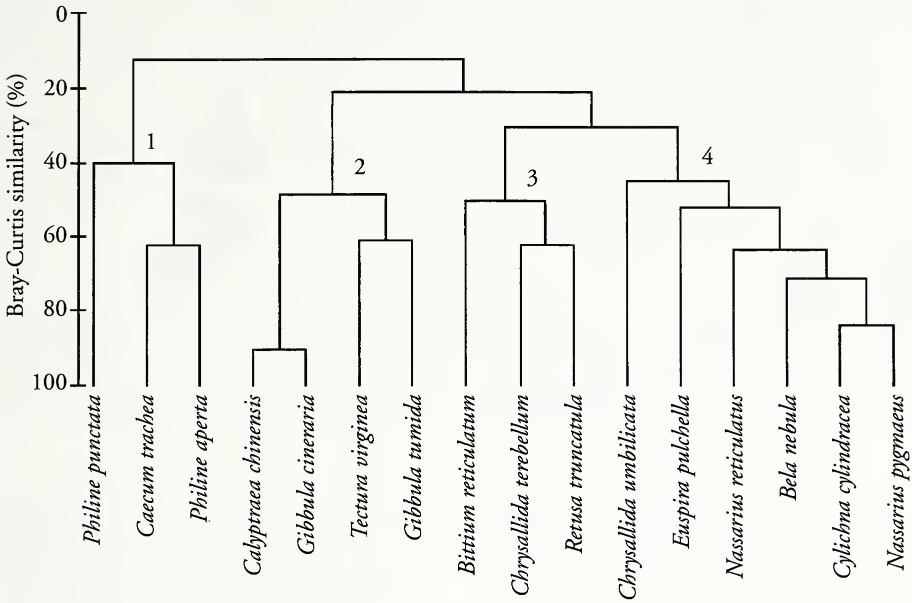

Figure 4. Dendrogram of classification of dominant species according to values of Bray-Curtis similarity index calculated on data of species abundance.
Figura 4. Dendrograma de clasificación de las especies dominantes en función del índice de similitud de Bray-Curtis calculado según los datos de abundancia de las especies.

CACABELOS, QUINTAS AND TRONCOSO (2008) found 34 species at the Ensenada de San Simón (Ría de Vigo).

Multivariate analyses showed that distribution and composition of gastropod assemblages are strongly related to the granulometric composition and the median grain size of the sediment. In fact, the same patterns have also been found for distribution of polychaetes and peracarid crustaceans in the same area (MOREIRA, QUINTAS AND TRONCOSO, 2006; MOREIRA, LOURIDO AND TRONCOSO, 2008). The distribution of sediments in the Ensenada de Baiona is, in turn, conditioned by patterns of local hydrodynamism (ALEJO AND VILAS, 1987; ALEJO ET AL., 1999). Indeed, hydrodynamism is regarded as the 'superparameter' acting as a source of disturbance for benthos at large scales (BREY, 1991); this superparameter affects other abiotic factors which also have a great influence on benthic assemblages, such as granulometric composition and availability of organic matter (MANCINELLI, FAZI AND ROSSI, 1998; ELÍAS, PALACIOS, RIVERO AND VALLARINO, 2005).

Sampling sites with a high content of the gravel fraction (group of sites B) have a gastropod fauna which is dominated by epifaunal species such as *Calyptraea chinensis*, trochids and limpets (Patellidae, Fissurellidae). These species can appear in numbers on sediments when stones or bioclastic components such as dead shells of other molluscs are present (RUEDA AND SALAS, 2003); those constitute the "hard" substrata in an otherwise soft bottom. Furthermore, some of those species, namely *Gibbula cineraria* and *C. chinensis*, were also found in numbers in fine-sand sites (group E, sites 17-18) because large shells of both *Lutraria* spp. and venerid bivalves were on the surface of the sediment. The gastropod assemblage from coarser sandy sediments was numerically dominated by *Caecum trachea*. High

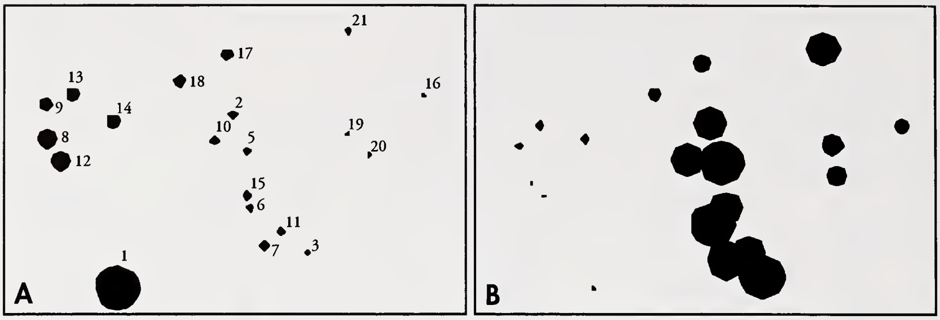

Figure 5. nMDS ordination of sampling sites with values of some abiotic variables superimposed. A, median grain size; B, very fine sand. Stress: 0.13.
Figura 5. Ordenación nMDS de los puntos de muestreo mostrando los valores de algunas variables abióticas superimpuestas. A, mediana del tamaño de grano; B, arena muy fina. Estrés: 0,13.

numbers of this species have also been reported from similar sediments in the Ría de Ares-Betanzos (TRONCOSO *ET AL.*, 2005) and the Ría de Aldán (LOURIDO *ET AL.*, 2006), this species being an important component in terms of abundance of the whole benthic assemblage. On the other hand, *Nassarius reticulatus* was found in a range of sediments, from gravel to mud, being the dominant gastropod in the fine-sand sediments. This is a common species in subtidal fine sediments in European Atlantic coasts in general (BARROSO, MOREIRA AND RICHARDSON, 2005), and in the Galician rias in particular (OLABARRIA, TRONCOSO AND URGORRI, 1998; TRONCOSO *ET AL.*, 2005). This species migrates from intertidal areas to subtidal areas in autumn (TALLMARK, 1980), which might explain its wide distribution through the inlet at the time of sampling, being present both in shallow and deeper sediments. Another abundant species in medium- and fine-sand sediments was the bullomorph *Cylichnina umbilicata*, which has scarcely been reported in the literature as a numerically dominant species in gastropod assemblages. This fact can be related to its small size (about 4 mm) and the extended use of sieving meshes greater than 500 μm, which can lead to an understimation of its abundance. In the Ensenada de Baiona, this species appears mostly in sandy sediments with a great content of the medium-sand fraction while the related species *Retusa truncatula* replaces the former in muddier sandy sediments. On the contrary, *R. truncatula* has frequently been found in sandy sediments in other rias, such as happens in the Ría de Ferrol (OLABARRIA *ET AL.*, 1998). The other representative of the Bullomorpha which has often been recorded from sandy and muddy sediments in the Galician rias is *Cylichna cylindracea* (GARMENDIA *ET AL.*, 1998; LOURIDO *ET AL.*, 2006). Nevertheless, in the Ensenada de Baiona this species was not so abundant as the other two aforementioned species and was only found in some sandy sites. Pyramidellidae was the family best represented in number of species at the Ensenada de Baiona. Nevertheless, many of the species were found in small numbers. Pyramidellids are ectoparasites of many marine invertebrates and tend to show specificity for their hosts (FRETTER AND GRAHAM, 1949). On soft-bottoms, polychaetes and bivalves are common hosts. The most abundant species at the Ensenada de Baiona was *Chrysallida terebellum*, which appeared in fine-sand sites and in muddy sand. At those sites, 'sedentary' polychaetes were abundant (MOREIRA *ET AL.*, 2006) which might favour the presence of *C. terebellum* in numbers there.

The smallest values for number of species and diversity were found at several shallow fine-sand sites close to

sandy beaches and at muddy sediments around the harbour of Baiona. In the first case, those sites are subjected to strong hydrodynamism all the year round, and particularly during winter (pers. obs.) This hydrodynamism might create an unstable sedimentary environment which is limitant for the establishment or many species, therefore resulting in poor gastropod assemblages (NETTO, ATTRILL AND WARWICK, 1999). This pattern has also been detected for polychaetes and peracarid crustaceans in the same sampling sites (MOREIRA *ET AL.*, 2006, 2008). On the other hand, sediments around the harbour of Baiona have turned from sandy to muddy in the last years and now support a poor gastropod assemblage, mostly at sites 16 and 19. Thus, ALEJO AND VILAS (1987) reported a dominance of the fine and very fine sand fractions in the sediment composition during the 1980's whereas we found percentages of silt-clay ranging from 74-90% in 1995. This increase in content of silt-clay might be due to the construction of the jetty which provides shelter against oceanic swell for the Baiona harbour. The presence of that jetty has indeed altered the hydrodynamic conditions in this area (ALEJO AND VILAS, 1987), thus allowing a greater rate of sedimentation of finer particles on the sheltered areas of the harbour. Although the quantitative data on the benthic fauna inhabiting those sediments previous to the construction of the jetty are not available, it can be suspected that this change in sedimentary composition has led to an impoverishment in the composition of the benthic assemblage as a whole, including its gastropod fauna. These and other similar alterations are frequent nowadays in coastal areas because of the increase of the human population living on the coast (CHAPMAN, 2006); this usually translates into a loss of local biodiversity and changes in the species composition of the assemblage. To prevent this, taking some simple measures such as building channels under breakwaters and jetties may improve hydrodynamic conditions (GUERRA-GARCÍA AND GARCÍA-GÓMEZ, 2004) and therefore prevent sedimentation in great quantities of both finer particles and organic matter.

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A new *Fusinus* (Gastropoda: Fasciolariidae) from the Algarve, south coast of Portugal

Una nueva especie de *Fusinus* (Gastropoda: Fasciolariidae) del Algarve, costa sur de Portugal

Roland HADORN*, Carlos M. L. AFONSO** and Emilio ROLÁN***

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ABSTRACT

Fusinus albacarinoides sp. nov. is described from south Portugal, off the Algarve coast, in 14-22 m depth. It is characterized by having a small red-brown to dark brown shell ornamented with a conspicuous white band at the periphery, with a rough shell surface, an elongate slender spire and a short siphonal canal. The new species is distinguished by its shell morphology and the soft parts from all other eastern Atlantic and Mediterranean *Fusinus* and is compared to a few of them.

RESUMEN

Se describe *Fusinus albacarinoides* sp. nov. del sur de Portugal, frente a la costa del Algarve, a 14-22 m de profundidad. Se caracteriza por una concha pequeña, pardo rojiza a pardo oscura, con una conspicua banda blanca en el borde, superficie rugosa, espira delgada y alargada y canal sifonal corto. Se distingue de otras especies de *Fusinus* del Atlántico este y Mediterráneo por la morfología de la concha y sus partes blandas. La especie es comparada con otras del género.

INTRODUCTION

Marine diversity is currently one of the most studied topics in ecology, especially within the framework of global and regional changes due to environmental and human impacts. The importance of well known benthic faunas for specific study areas or geographical regions is the first and most important step towards proper characterization and management. Within the Algarve region in south Portugal, very few studies dealing with marine molluscs associated with permanently submerged rocky ecosystems have been carried out up until now. To fulfill this gap and contribute to the mapping of marine biotopes a baseline study was carried out (RENSUB II project) by the Centre of Marine Sciences of the Algarve (GONÇALVES *ET AL.*, 2007).

Between May 2003 and April 2006 more then 90 different stations in the Central Algarve region were studied seasonally. With the use of scuba diving gear mollusc samples were recovered from these stations and after proper observation we found a well-defined

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Fusinus species which does not match the description of any other known *Fusinus* species reported for the Atlantic and Mediterranean Sea.

Details of shell and radular morphology as well as animal soft parts are presented and the new species is compared to related known *taxa*.

Abbreviations

ANSP: Academy of Natural Sciences of Philadelphia, Pennsylvania, USA
CCMLA: Collection Carlos M. L. Afonso, Faro, Portugal
CER: Collection Emilio Rolán, Vigo, Spain
CRH: Collection Roland Hadorn, Röthenbach, Switzerland
IPM: Instituto Português de Malacologia, Zoomarine, Guia, Portugal
lv: live collected
MNCN: Museo Nacional de Ciencias Naturales de Madrid, Spain
MNHN: Muséum National d'Histoire Naturelle, Paris, France

SYSTEMATICS

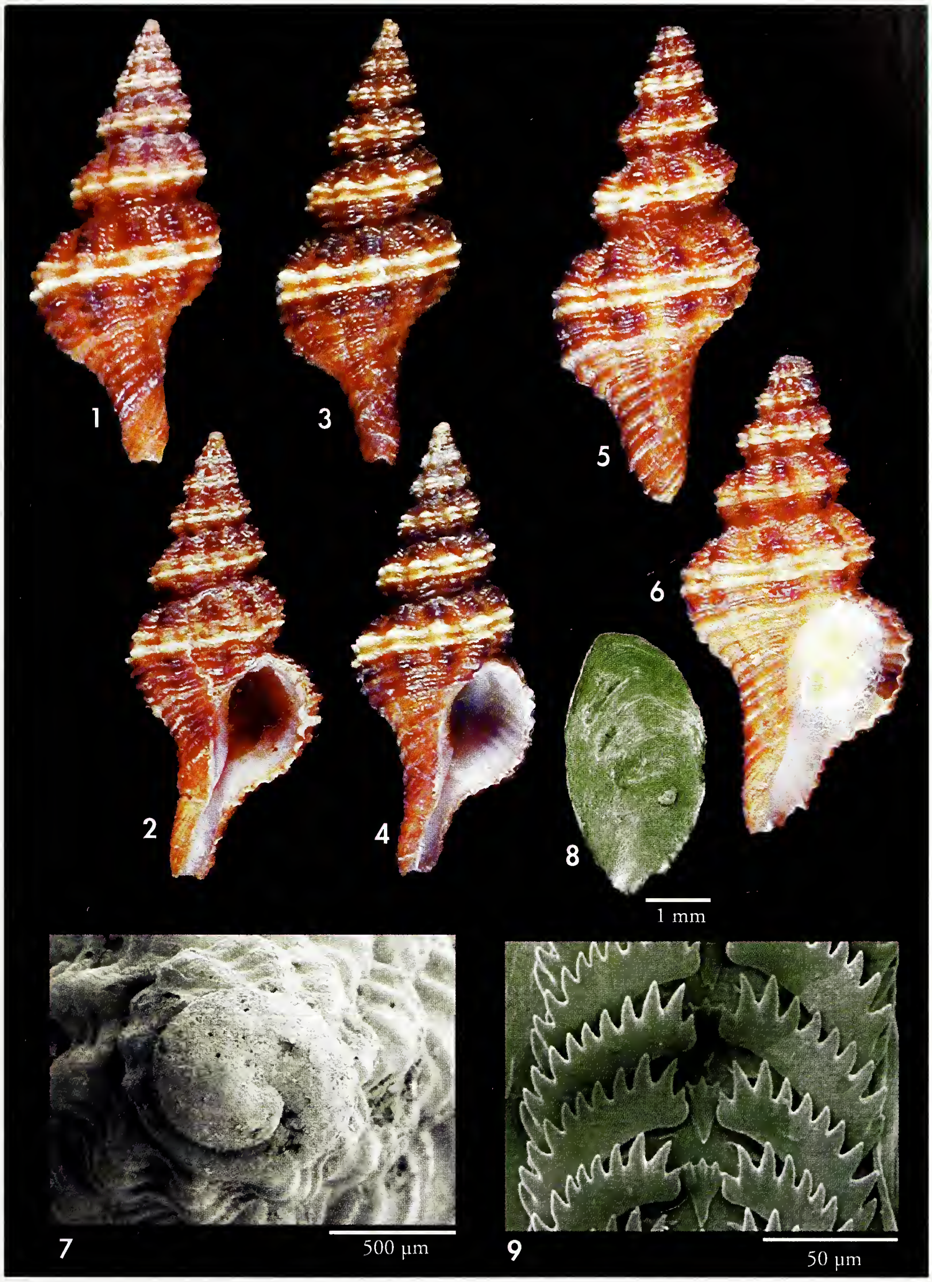
Family FASCIOLARIIDAE Gray, 1853
Genus *Fusinus* Rafinesque, 1815

Fusinus Rafinesque, 1815: 145. Substitute name for '*Fusus* Lamarck 1799' [=*Fusus* Bruguière, 1789], non *Fusus* Helbling, 1779.
Type species: *Murex colus* Linnaeus, 1758, by typification of replaced name.

Fusinus albacarinoides sp. nov. (Figs. 1-12)

Type material: Holotype (18.5 x 8.1 mm, lv) MNHN 21130, south Portugal, Algarve, Baía de Pêra, 2 km offshore Armação de Pêra, 37° 04′ 47.1 N, 8° 21′ 41.8 W, 17-20 m deep, collected by Carlos M. L. Afonso in March 2006. Paratype 1 (20.6 x 8.2 mm, lv) IPM.014T, same data; paratype 2 (18.5 x 7.6 mm, lv) MNCN 15.05/47.562, same data; paratype 3 (19.2 x 7.5 mm, lv) ANSP, same data; paratype 4 (21.1 x 8.2 mm, lv) CCMLA, same data; paratype 5 (17.9 x 7.2 mm, lv) CCMLA, same data; paratype 6 (21.3 x 9.3 mm, lv) CRH, same data; paratype 7 (20.7 x 8.0 mm, lv) CRH, same data; paratype 8 (17.3 x 6.8 mm, lv) CER, same data.
Other material examined: 5 additional specimens collected from the type locality. Numerous live taken specimens from following stations: Pedra do Alto, 2.7 km off Oura (37° 03′ 29.2 N, 8° 12′ 34.7 W); Galé Alta, 2.3 km off Galé (37° 04′ 09.3 N, 8° 19′ 52.1 W), 17-19 m deep; Pedra Perdida, 2.4 km offshore between Galé and Armação de Pêra (37° 03′ 26.2 N, 8° 19′ 35.1 W), 20 m deep; Valados Este, 3.7 km offshore between Galé and Armação de Pêra (37° 02′ 19.3 N, 8° 19′ 18.3 W), 20-22 m deep; Estragad, 1.6 km offshore Galé (37° 03′ 29.8 N, 8° 18′ 14.6 W), 20-22 m deep; Pêra, 2.4 km offshore between Galé and Armação de Pêra (37° 04′ 47.1 N, 8° 18′ 14.6 W), 17-19 m deep; Lastro, 1.6 km offshore Marinha (37° 04′ 37.2 N, 8° 24′ 27.9 W), 14-16 m deep.
Type locality: Baía de Pêra, 2 km offshore Armação de Pêra (37° 04′ 47.1 N, 8° 21′ 41.8 W), Algarve, south Portugal.
Etymology: *Fusinus albacarinoides* sp. nov. is derived from *albus* (Latin, adj.) meaning "white" in combination with *carina* (Latin, noun, fem.), a keel. The white peripherical band along the shell recalls the white foaming water of the wake behind a moving ship.

Description: Shell small for genus (up to 22 mm in length), fusiform, thin, lightweight, with long pointed spire and short siphonal canal, consisting of 8 strongly convex whorls (including protoconch). Surface of the shell roughened by numerous thin growth striae making the spiral cords nearly granular, often forming fine scales or lamellae crossing the spiral sculpture between interspaces of axial ribs on latter whorls. Suture constricted, slightly wavy according to the axial sculpture. Below suture often with a conspicuous band of well-visible scales formed by growth striae. Shell red-brown to dark brown with a conspicuous broad



Figures 1-9. *Fusinus albacarinoides* spec. nov., south Portugal, Algarve coast, off Armação de Pêra, about 3 miles offshore. 1, 2: holotype MNHN 21130, 18.5 mm; 3, 4: paratype 2 MNCN 15.05/47.562, 18.5 mm; 5, 6: shell, CCMLA, colour variant, 21.3 mm; 7: protoconch (slightly eroded); 8: operculum; 9: radula (7-9 from a specimen of 19.4 mm).

Figuras 1-9. Fusinus albacarinoides *spec. nov., sur de Portugal, costa del Algarve, cerca de 3 millas frente a Armação de Pêra. 1, 2: holotipo MNHN 21130, 18.5 mm; 3, 4: paratipo 2 MNCN 15.05/47.562, 18,5 mm; 5, 6: concha, CCMLA, variante de color, 21,3 mm; 7: protoconcha (algo erosionada); 8: opérculo; 9: rádula (7-9 de un ejemplar de 19,4 mm).*

white or yellowish band at periphery and usually with an indistinct second white or light brown band on parietal wall which is only visible on body whorl.

Protoconch paucispiral, bulbous, light brown, consisting of 1 ? smooth glossy whorls, final part with 1-2 fine axial riblets reaching from suture to suture, transition to teleoconch abrupt, marked by a varix. Diameter 0.8-0.9 mm.

Axial sculpture consisting of broad, rather weak axial ribs reaching from suture to suture on all postnuclear whorls. Interspaces between axial ribs rather broad, only slightly impressed. 8 or 9 axial ribs on upper whorls, 8-10 on antepenultimate, 8-11 on penultimate and 8-13 on body whorl.

Spiral sculpture usually darker than the background colour, consisting of broad coarse spiral cords with rough surface caused by numerous thin growth striae. Teleoconch beginning with 3 or 4 primary spiral cords, 4 on second whorl, 5 on third whorl, 6 on fourth, and 7 on latter whorls. Spiral cords 3 and 4, counted from the lower suture, are always the strongest and white coloured (occasionally yellowish or light brown). Secondary spiral cords appear between the primary cords from third or fourth whorl on, at the beginning fine and inconspicuous but occasionally becoming nearly as strong as the primary cords on body whorl. About 20-22 strong spiral cords behind the outer lip, becoming weaker towards the tip of the siphonal canal.

Aperture ovate, rounded above, slightly constricted below, posterior canal inconspicuous. Juvenile or subadult specimens with a thin transparent body whorl showing colouration of the outer side of the shell. Adult specimens white inside aperture, ornamented with 8-10 sharp but fine folds forming tiny usually white teeth on outer lip. Outer lip convex, edge finely crenulated. Parietal callus thin, white or transparent, glossy, adherent, not detached from the parietal wall. Underlying spiral sculpture sometimes still visible. No columellar folds.

Siphonal canal usually slightly shorter than aperture length, straight or slightly curved, widely open.

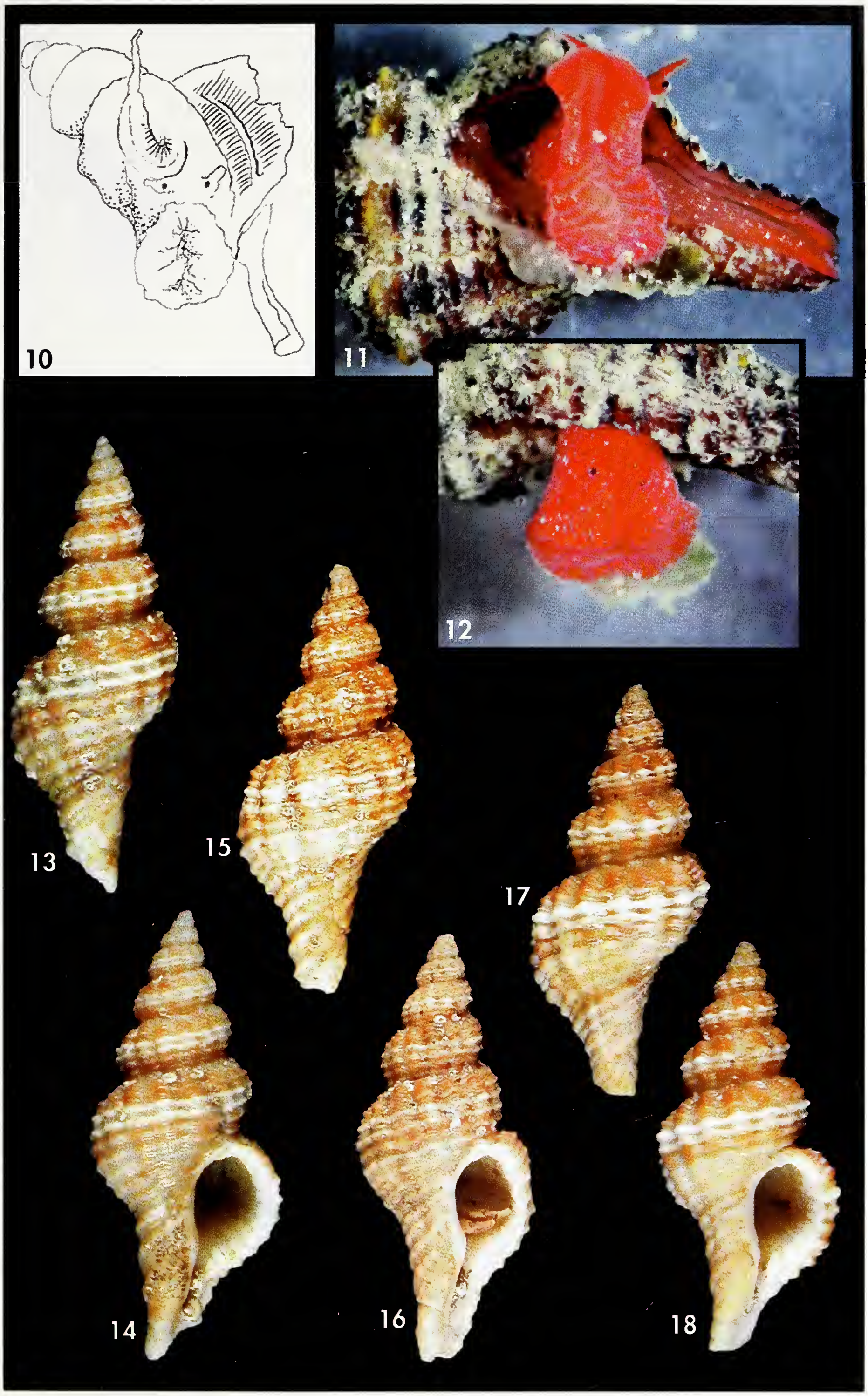
Operculum (Fig. 8) corneous, thin, yellowish, shape and size corresponding to aperture, nucleus apical.

Radula (Fig. 9) with tricuspid, elongate, almost triangulate central tooth. Base rather narrow, top pointed, both sides slightly concave. Cusps rather small, pointed, slightly projecting below the base, central one slightly stronger and longer. Lateral teeth elongate, slightly curved, with 9-10 rather short pointed cusps with incurved tips. Two innermost cusps longest and most prominent. At inner end with a small denticle.

Anatomy: Animal (Figs. 11, 12) bright red and irregularly speckled with white spots of different sizes, scattered all over the body including tentacles. Siphon also spotted, paler in colour. Tentacles

(Right page) Figures 10-12. *Fusinus albacarinoides* spec. nov., south Portugal, Algarve coast, off Armação de Pêra, about 3 miles offshore. 10: animal (drawing by Emilio Rolán), 19.4 mm; 11: living animal; 12: detail of the tentacles (photographs by Carlos M. L. Afonso). Figures 13-18. *Fusinus cretellai* Buzzurro and Russo, 2008 (=*Fusus crassus* Pallary, 1901), North Morocco, Bay of Tangier. 13, 14: lectotype of *Fusus crassus* Pallary, 1901, MNHN Moll 6492, 28.1 mm; 15, 16: paralectotype of *Fusus crassus* Pallary, 1901, MNHN Moll 6490, 26.5 mm; 17, 18: paralectotype of *Fusus crassus* Pallary, 1901, MNHN Moll 6490, 25.0 mm.

(Página derecha) Figuras 10-12. Fusinus albacarinoides *spec. nov., sur de Portugal, costa del Algarve, cerca de 3 millas frente a Armação de Pêra.* 10: animal (dibujo de Emilio Rolán), 19,4 mm; 11: animal vivo; 12: detalle de los tentáculos (fotografías de Carlos M. L. Afonso). *Figuras 13-18.* Fusinus cretellai *Buzzurro and Russo, 2008 (*=Fusus crassus *Pallary, 1901), norte de Marruecos, bahía de Tánger. 13, 14: lectotipo de* Fusus crassus *Pallary, 1901, MNHN Moll 6492, 28,1 mm; 15, 16: paralectotipo de* Fusus crassus *Pallary, 1901, MNHN Moll 6490, 26,5 mm; 17, 18: paralectotipo de* Fusus crassus *Pallary, 1901, MNHN Moll 6490, 25,0 mm.*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long, broader at their base, tapering, each with a small black eye at end of broad part (after one third of length of tentacle). Extreme part of mantle has some angular brown lines which must correspond to the darker parts of the shell. Penis (Fig. 10) large, distinctive, rather slender and flat in the first half of its length and then, on the second half of its length, suddenly becoming conspicuously slender with a pointed tip, without a penial appendage.

Range and habitat: Known from southern Portugal, off the Algarve coast, between Oura (37° 03′ 29.2 N, 8° 12′ 34.7 W) and Marinha (37° 04′ 37.2 N, 8° 24′ 27.9 W) between 1.6 and 4.0 km offshore. Not found in shallow water, bathymetric range starts from 14-22 m down, mostly collected attached under rocks lying on rock platforms with fine sandy bottom. The new species is always associated with rocky bottoms.

Discussion: Only few other *Fusinus* species are reported from the infralittoral zone of southern Portugal, Algarve coast: *F. pulchellus* (Philippi, 1844), *F. rostratus* (Olivi, 1792) and *F. syracusanus* (Linnaeus, 1758). However, the occurrence of *F. syracusanus* in the Atlantic cannot be confirmed despite intensive research along the Algarve coast.

Some other *Fusinus* species from the eastern Atlantic and the Canary Islands are similar in shape and sculpture and therefore also compared to *F. albacarinoides* sp. nov..

Hadorn and Rolán (1999) redescribed *Fusinus crassus* (Pallary, 1901) and selected a lectotype, among several syntype lots housed in MNHN, originating from Tangier, on the Atlantic coast of north Morocco. Buzzurro and Russo (2007: 184-186) described and well figured *F. crassus* (Pallary, 1901) from a population from the Mediterranean, southern Spain, and noticed that the name established by Pallary is a primary homonym and could not be used. Therefore *F. cretellai* Buzzurro and Russo, 2008 was established for this species as a replacement name for *Fusus crassus* Pallary, 1901, which is a junior homonym of *Fusus crassus* Brown, 1827 (a recent Turrid from Scotland).

F. cretellai is most similar to *F. albacarinoides* sp. nov.. *F. cretellai* is known from two populations (Table I): originally described from the Atlantic coast of North Morocco, Tangier (type locality), and the other one from southern Spain (from the Mediterranean, from Fuengirola, Algeciras and Getares and from the Atlantic coast from Cape Trafalgar). *F. cretellai* from north Morocco (Figs. 13-18) differs from specimens from southern Spain (Figs. 19-22) by the somewhat larger shell size (Morocco: up to 28.0 mm

(Right page) Figures 19-22. *Fusinus cretellai* Buzzurro and Russo, 2008. 19, 20: shell, CRH, south Spain, Mediterranean Sea, Getares, 23.4 mm; 21, 22: shell, CRH, south Spain, off Cape Trafalgar, Cadiz, 19.3 mm. Figures 23, 24. *Fusinus tenerifensis* Hadorn and Rolán, 1999; paratype 5 CRH, Canary Islands, Tenerife, 21.7 mm. Figures 25-28. *Fusinus pulchellus* (Philippi, 1844). 25, 26: shell, CRH, southern France, Côte d Azur, Saint-Raphaël Le Dramont, 15.0 mm; 27, 28: shell, CCMLA, morphotype "quandumpulchellus", south Portugal, Algarve, Lagos, off Ponta da Piedade, 40-55 m deep, 28.9 mm. Figures 29, 30. *Fusinus rostratus* (Olivi, 1792), shell, CCMLA, south Portugal, Algarve, Lagos, off Ponta da Piedade, 40-55 m deep, 34.6 mm.

(Página derecha) Figuras 19-22. Fusinus cretellai *Buzzurro and Russo, 2008. 19, 20: concha, CRH, sur de España, Mediterráneo, Getares, 23,4 mm; 21, 22: concha, CRH, sur de España, frente al cabo de Trafalgar, Cádiz, 19,3 mm. Figuras 23, 24.* Fusinus tenerifensis *Hadorn and Rolán, 1999; paratipo 5 CRH, Islas Canarias, Tenerife, 21,7 mm. Figuras 25-28.* Fusinus pulchellus *(Philippi, 1844). 25, 26: concha, CRH, sur de Francia, Côte d Azur, Saint-Raphaël Le Dramont, 15,0 mm; 27, 28: concha, CCMLA, morfotipo "quandumpulchellus", sur de Portugal, Algarve, Lagos, frente a Ponta da Piedade, profundidad 40-55 m, 28,9 mm. Figuras 29, 30.* Fusinus rostratus *(Olivi, 1792), concha, CCMLA, sur de Portugal, Algarve, Lagos, frente a Ponta da Piedade, profundidad 40-55 m, 34,6 mm.*

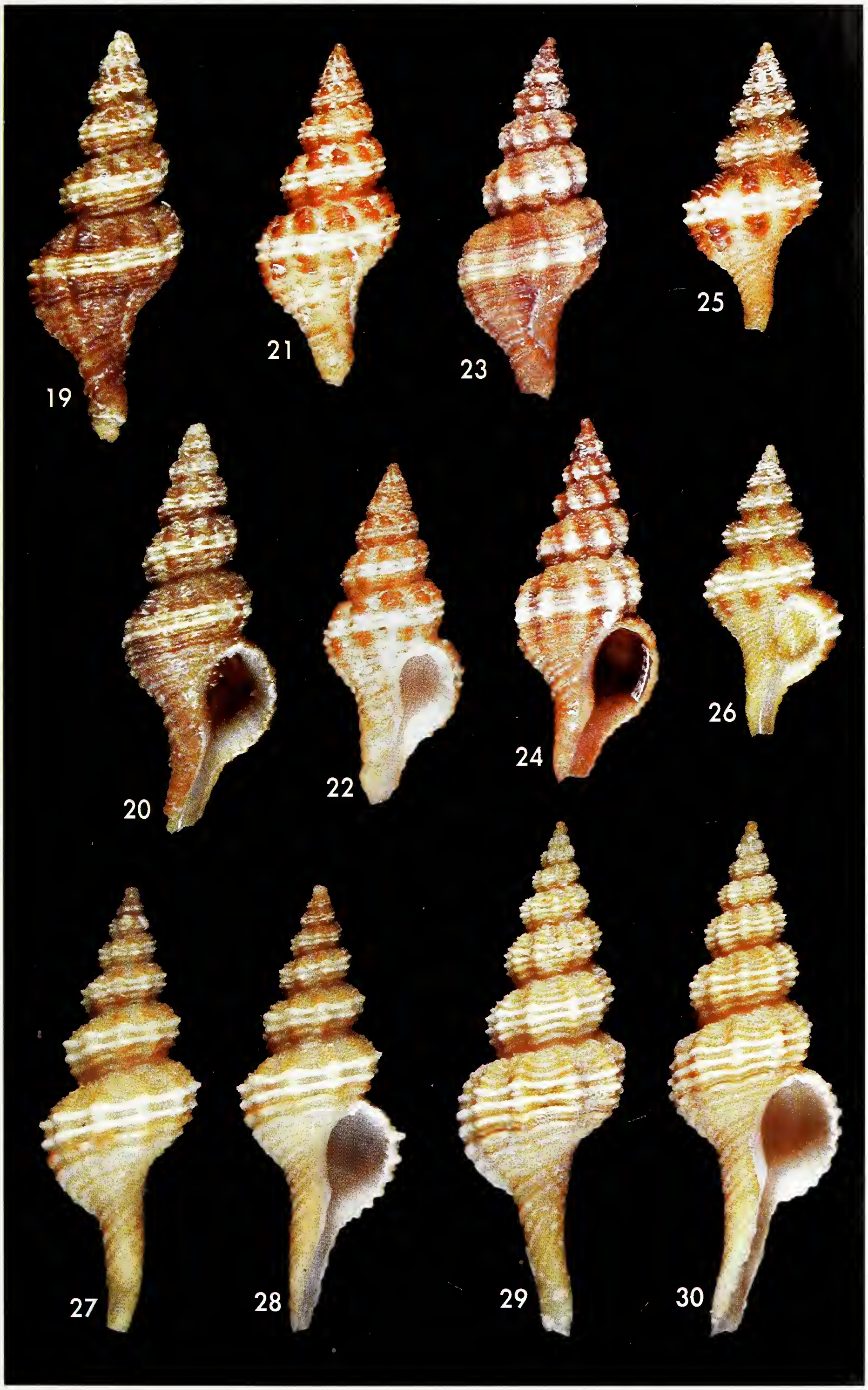
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Table I. Conchometrical parameters of F. cretellai and F. albacarinoides
Tabla I. Parámetros conquiológicos de F. cretellai *y* F. albacarinoides

No.	Height (H) mm	Diameter (D) mm	Ratio H/D	Remarks
F. cretellai Buzzurro and Russo, 2008 (= *Fusus crassus* Pallary, 1901), from North Morocco, Bay of Tangier (type locality) (lectotype and paralectotypes MNHN)				
1	28.1	11.0	2.55	Lectotype MNHN Moll. 6492 (Figs. 13-14)
2	26.5	10.9	2.43	Paralectotype MNHN Moll. 6490 (Figs. 15-16)
3	24.1	10.2	2.36	Paralectotype MNHN Moll. 6490
4	25.0	10.7	2.34	Paralectotype MNHN Moll. 6490 (Figs. 17-18)
5	23.6	10.3	2.29	Paralectotype MNHN Moll. 6490
6	22.8	9.4	2.43	Paralectotype MNHN Moll. 6490
7	22.7	10.3	2.20	Paralectotype MNHN Moll. 6490
8	26.3	11.3	2.33	Paralectotype MNHN Moll. 6491
9	25.8	10.6	2.43	Paralectotype MNHN Moll. 6491
10	22.7	10.0	2.27	Paralectotype MNHN Moll. 6491
11	23.0	9.8	2.35	Paralectotype MNHN Moll. 6491
12	22.9	8.9	2.57	Paralectotype MNHN Moll. 6491
13	19.9	8.9	2.24	Paralectotype MNHN Moll. 6491
		average	2.37	
F. cretellai Buzzurro and Russo, 2008 from southern Spain (as *F. crassus* after Buzzurro and Russo, 2007: 203)				
1	23.5	8.5	2.76	Buzzurro and Russo (2007: 203)
2	24.0	8.9	2.70	Buzzurro and Russo (2007: 203)
3	23.0	9.0	2.56	Buzzurro and Russo (2007: 203)
4	22.5	8.5	2.65	Buzzurro and Russo (2007: 203)
5	23.5	8.3	2.83	Buzzurro and Russo (2007: 203)
6	23.5	9.8	2.40	Buzzurro and Russo (2007: 203)
7	23.0	8.8	2.61	Buzzurro and Russo (2007: 203)
8	22.5	8.5	2.65	Buzzurro and Russo (2007: 203)
9	23.4	9.1	2.57	CRH (Figs. 19-20)
10	19.3	7.6	2.54	CRH (Figs. 21-22)
		average	2.63	
F. albacarinoides sp. nov. from the Algarve, Portugal				
1	18.5	8.1	2.28	Holotype MNHN 21130
2	20.6	8.2	2.51	Paratype 1 IPM.014T
3	18.5	7.6	2.43	Paratype 2 MNCN 15.05/47.562
4	19.2	7.5	2.56	Paratype 3 ANSP
5	21.1	8.2	2.57	Paratype 4 CCMLA
6	17.9	7.2	2.49	Paratype 5 CCMLA
7	21.3	9.3	2.29	Paratype 6 CRH
8	20.7	8.0	2.59	Paratype 7 CRH
9	17.3	6.8	2.54	Paratype 8 CER
10	23.5	9.5	2.47	CRH
11	19.7	8.0	2.46	CRH
12	21.3	9.6	2.22	CCMLA
13	21.3	9.3	2.29	CRH
14	20.4	7.9	2.58	CRH
15	11.8	5.1	2.31	CRH
16	13.7	5.8	2.36	CCMLA
17	14.4	6.1	2.36	CCMLA
18	16.7	6.5	2.57	CCMLA
		average	2.44	

/ southern Spain: up to 24.0 mm), the comparatively broader shell (ratio length/diameter: Morocco: 2.37 / southern Spain: 2.63), the shorter spire, the thicker shell, the inflated body whorl, the predominant and deeper incised spiral sculpture on body whorl, the more close-set axial ribs with narrow and shallow interspaces, the larger number of axial ribs on body whorl, the entirely white aperture, the strong internal lirae, and the broader, stout siphonal canal with 3-4 conspicuously strong and broad, widely spaced white spiral cords on outer side of siphonal canal.

But the differences between the two populations are not consistent and linking specimens exists (e.g. BUZZURRO AND RUSSO, 2007: pl. 26, fig. e). As long as fresh material of *F. cretellai* from North Morocco with intact protoconch and soft parts is not available for study, we prefer not to describe the southern Spain population as a distinct species.

F. cretellai (Figs. 13-18) from North Morocco, Tangier (type locality), differs from *F. albacarinoides* sp. nov. by the larger shell size (20-28 mm), the thicker and more solid shell, the smoother surface, the shorter spire, the less constricted suture, the less prominent but more close-set axial ribs, the longer and stronger siphonal canal, the prominent but less numerous spiral cords on the outer side of the siphonal canal, and by the entirely white aperture and the thick outer lip.

F. cretellai (Figs. 19-22) from southern Spain is most similar to *F. albacarinoides* sp. nov., but differs by the lighter coloured shell, the smaller protoconch (diameter 0.7 mm instead of 0.8-0.9 mm), the smoother surface, the weaker and less prominent spiral sculpture especially at periphery, and by the distinct white tooth near the posterior canal. The radula is very similar and not distinctive, but the animal differs considerably. The animal of *F. cretellai* is bright red in colour (BUZZURRO AND RUSSO, 2007: 185), but in *F. albacarinoides* bright red with numerous white speckles all over the animal including tentacles and siphon. But most distinctive is the completely different penis (different shape and with a short penial appendage in *F. cretellai*). For details we refer to BUZZURRO AND RUSSO, 2007: 185, pl. 9, figs. d-e. Moreover, *F. cretellai* lives under stones, generally with a reduced weed cover, at depths of 2-5 m (Buzzurro and Russo, 2007: 184); *F. albacarinoides* sp. nov. lives in deeper water starting from 14-22 m down.

F. pulchellus (Philippi, 1844) (Figs. 25-28) from the Mediterranean Sea, lives at depths of 2 to 120 meters, and was recorded also from the Atlantic Ocean, from Portugal and Atlantic coasts of Spain and from the Canary Islands (BUZZURRO AND RUSSO, 2007: 148-149). The second author obtained *F. pulchellus* from the Algarve coast from local fishermen collected in gill and tangle nets, depth 35 m down and associated to muddy Bryozoan bottoms of *Adeonella calveti*. We compare *F. albacarinoides* sp. nov. to the larger morphotype "quandumpulchellus" figured by SNYDER (2000: 174, figs 1A, 1B). BUZZURRO AND RUSSO (2007: 149-154) placed *F. quandumpulchellus* Snyder, 2000, in synonymy of *F. pulchellus* (Philippi, 1844). *F. pulchellus* differs by the smaller number but more prominent and wider spaced axial ribs, the lighter coloured shell, and the longer, straight and more slender siphonal canal. The animal of *F. pulchellus* differs by a distinctive large, very stubby penis, triangular in shape (BUZZURRO AND RUSSO, 2007: 150; pl. 4, figs. a-b).

F. rostratus (Olivi, 1792) (Figs. 29-30) is distributed all over the Mediterranean Sea, also the Atlantic coasts, namely from Portugal to the Canary Islands, also recorded from Moroccan coasts, Spain, France and Mauritania (BUZZURRO AND RUSSO, 2007: 138). *F. rostratus* often has a rough surface produced by numerous thin axial growth striae, forming fine scales and nearly granular spiral cords, but differs by the larger size (45-55 mm on the average), by the distinct prominent axial sculpture, the usually uniformly coloured shell, and the long straight siphonal canal.

F. syracusanus (Linnaeus, 1758), an infralittoral species distributed throughout the Mediterranean Sea, also occurring

in the eastern Atlantic, from Portugal to the Canary Islands (Buzzurro and Russo, 2007: 178), differs by the larger size, the stout but light and broad shell, the carinated, well-shouldered whorls, and the distinct close-set, regularly spaced and usually white coloured axial ribs.

F. tenerifensis Hadorn and Rolán, 1999 (Figs. 23-24) from the Canary Islands (Tenerife and La Palma) is similar in shape, sculpture and colouration, but differs by the red brown protoconch, the dark brown to chocolate-brown colouration, the more prominent and well-spaced axial ribs, the dark brown, sometimes slightly purplish aperture, and usually by the less conspicuous white band, and the shorter siphonal canal.

Some other *Fusinus* species are recorded from the Ibero-Moroccan Gulf, from the Atlantic coasts of Portugal or Morocco, but none of them is similar to *F. albacarinoides* sp. nov.:

F. sectus (Locard, 1897), known only from the holotype (figured in Hadorn and Ryall, 1999: 34, figs. 1-2), collected from off Mauritania 882 m deep, differs by the broader and shorter spire and the uniformly coloured shell.

F. agadirensis Hadorn and Rolán, 1999, from the Atlantic coast of Morocco, collected between Agadir and Casablanca 50-70 m deep, differs by the smaller shell size (up to 16.6 mm), the uniform light brown shell, and the distinct regularly spaced axial and spiral ribs.

F. boucheti Hadorn and Ryall, 1999, from the Atlantic coast of Morocco and the Canary Islands, collected 480-724 m deep, differs by the larger shell size (up to 45.8 mm), the larger protoconch (diameter 1.3-1.8 mm), the longer siphonal canal, and the uniformly coloured shell.

F. bocagei bocagei (P. Fischer, 1882), distributed from the Bay of Biscay to the Ibero-Moroccan Gulf, the Azores and the Canary and Cape Verde Islands, collected 225-3215 m deep, differs by the larger size (24-38 mm), the prominent broad, well-spaced axial ribs, the simple inconspicuous spiral sculpture, and the uniformly coloured shell.

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We are grateful to Koen Fraussen, Belgium, for his kind support, helpful suggestions and for making the plates, the late Giovanni Buzzurro, Italy, and Pablo Pedro Modroño de la Rosa, Spain, for providing comparison material. We thank also Virginie Héros, Muséum National d'Histoire Naturelle, Paris, France, for the loan of type material. We would like to thank our colleagues who took part in the RENSUB II project (Underwater Visual Census) namely J.M.S. Gonçalves (coordinator), P. Monteiro, R. Coelho, C. Almeida, P. Veiga, F. Oliveira, J. Ribeiro, D. Abecasis and L. Bentes. Funds for this study were provided by the Algarve Regional Administration (Comissão de Coordenação de Desenvolvimento Regional do Algarve – CCDR Algarve). SEM photographs made by Jesús Méndez in CACTI (Centro de Apoyo Científico y Tecnológico) of the University of Vigo.

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Two new species of *Crassispira* (Gastropoda, Conoidea) from West Africa with a taxonomic note on *Crassispira tripter* von Maltzan, 1883

Dos nuevas especies de *Crassispira* (Gastropoda, Conoidea) de África occidental con una nota taxonómica sobre *Crassisipira tripter* von Maltzan, 1883

Peter RYALL*, Juan HORRO** and Emilio ROLÁN***

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ABSTRACT

A previous suggestion that *Drillia tripter* von Maltzan, 1883 should be assigned to the genus *Crassispira* Swainson, 1840 is confirmed. Two new species of this genus are described and illustrated from West Africa and compared to other similar species from this area.

RESUMEN

Se confirma la asignación de *Drillia tripter* von Maltzan, 1883 al género *Crassispira* Swainson, 1840, que había sido previamente sugerida. Se describen e ilustran dos nuevas especies de este género de África occidental, haciendo comparación con otras congenéricas.

INTRODUCTION

The genus *Crassispira* Swainson, 1840 from West Africa had been reviewed by FERNANDES, ROLÁN, AND OTERO-SCHMITT (1995), who identified ten species, describing five as new and mentioning yet another as undetermined. ROLÁN, RYALL AND HORRO (2007) increased this number with the description of a new species endemic of south Angola and commented that another known species would probably be better placed in this genus: *Drillia tripter* von Maltzan, 1883. Studies of this species have now confirmed that it is a *Crassispira*.

The authors have also recently been able to examine material collected from two different localities in West Africa that matches the characteristics of this genus as outlined by POWELL (1966). In both cases the material was obtained by scuba diving, a collecting method relatively new to the region. This technique has already led to other new species being newly discovered in West Africa. Specimen collection had previously been limited to intertidal searching, snorkel diving naturally limited to a maximum depth of 15 meters, dredging

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in sandy areas or as a by-product from fishermens' nets, trawls and traps. But with the introduction of scuba diving, some previously inaccessible areas can now be studied and these deeper rocky habitats are now revealing some species new to science.

The generic assignation of *Drillia tripter* von Maltzan, 1883 and the description of two new species of *Crassispira* are the subject of the present work.

MATERIAL

The material of the new species from Senegal has been collected by Alex Trencart and Jacques Pelorce by scuba diving at 30-37 meters off Dakar, Senegal. That from Sao Tomé Island has been collected by Sandro Gori at 43 meters on small rounded stones at Minerio Reef. It is to be noted that at such depths "down time" is severely limited to avoid decompression stops on the diver's ascent. We also studied the type material from the Berlin Museum of *Drillia tripter* von Maltzan, 1883 as well as numerous specimens from the collections of Jacques Pelorce, Frank Boyer, José María Hernández Otero and the three authors,; all of this material is from the Dakar area of Senegal.

Abbreviations:

MHNS Museo de Historia Natural "Luis Iglesias" University of Santiago de Compostela.
MNCN Museo Nacional de Ciencias Naturales, Madrid.
MNHN Muséum national d'Histoire naturelle, Paris.
ZMB Zoologisches Museum, Berlin
CAT collection of Alex Trencart, Paris
CFB collection of Frank Boyer, Sevran
CHO collection of José María Hernández, Gran Canaria
CJH collection of Juan Horro, Vigo
CJP collection Jacques Pellorce, Paris
CPR collection of Peter Ryall, Maria Rain
CSG collection Sandro Gori, Livorno
sp specimen with soft parts
s empty shell
j juvenile
LC length of the shell
DR length of the radular tooth

SYSTEMATICS

Family TURRIDAE Swainson, 1840
Subfamily CRASSISPIRINAE Morrison, 1966
Genus *Crassispira* Swainson, 1840

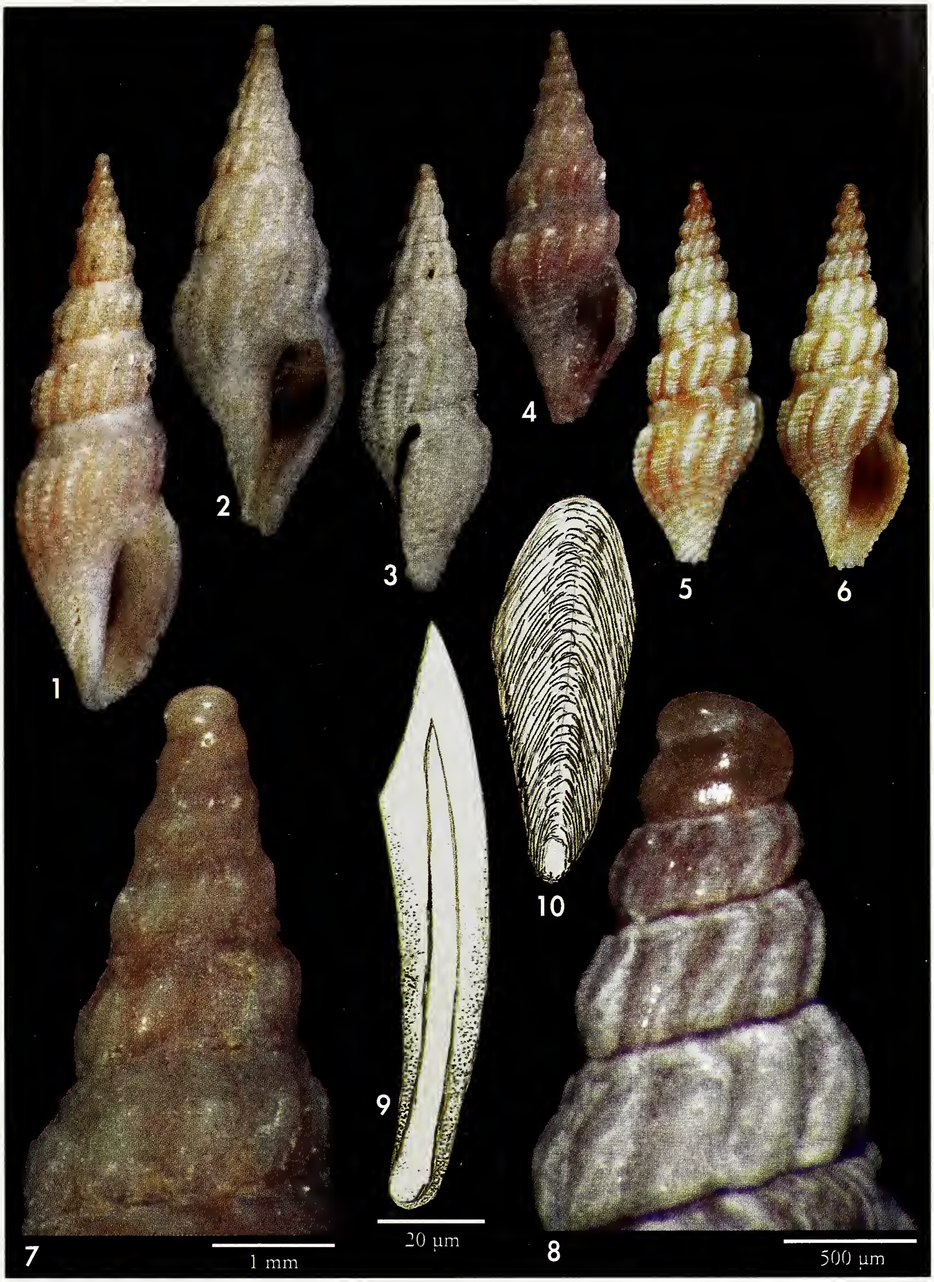
Type species (s. d.): *Pleurotoma bottae* Kiener, 1840

Crassispira tripter (von Maltzan, 1883) (Figs. 1-10)

Type material: Two series of syntypes, references ZMB/Moll-37221, 4 dried shells (Figs. 1-3) and ZMB/Moll-112616, 2 dried shells (Fig. 4) this lot ex coll. Paetel (both leg. Von Maltzan).
Other material examined: 5 sp and 25 s, Cap Vert, Dakar (CJP); 5 sp from Dakar (MHNS); 3 sp, 5 s from Dakar (CHO); 19 s from Dakar (CFB).
Type locality: Gorèe Island, Dakar, Senegal.

Description: NOLF (2008) has restated the main features of this species and we therefore refer readers to the original description as well as to this recent work for details of the shell. The shell is illustrated in the present work (Figs 1-6)

It is necessary to add a description of the protoconch (Figs. 7, 8) which is rounded, smooth, shiny, brown with a little more than one whorl, suture marked and there is a clear transition with the teleconch. As would be expec-



Figures 1-10. *Crassispira tripter* (von Maltzan, 1883), Gorée, Senegal; 1-3: syntypes, 23.0, 20.5 and 15.6 mm, (ZMB/Moll-37221); 4: syntype, 14.3 mm (ZMB/Moll-112616, ex coll. Paetel); 5-6: shell, 14.2 mm(CHO); 7: protoconch of the syntype of fig. 4; 8: protoconch of a non-type shell (CFB). 9: marginal tooth of the radula; 10: operculum, 4 mm, from a specimen 17.1 mm.

Figuras 1-10. Crassispira tripter *(von Maltzan, 1883), Gorée, Senegal; 1-3: sintipos, 23,0, 20,5 y 15,6 mm, (ZMB/Moll-37221); 4: sintipo, 14,3 mm (ZMB/Moll-112616, ex coll. Paetel); 5-6: concha, 14,2 mm(CHO); 7: protoconcha del sintipo fig. 4; 8: protoconcha de un ejemplar no tipo (CFB). 9: diente marginal de la rádula; 10: opérculo, 4 mm, de un ejemplar 17,1 mm.*

ted with a species of direct development its size is a little variable ranging from 700 mm to 1 mm in diameter.

Dimensions: The largest syntype is 23 mm (Fig. 1); maximum size observed 24.56 mm (CFB), usually between 15-19 mm.

Animal: We studied an alcohol preserved specimen. The head is dark around the tentacles and in the base are the eyes. On the right dorsal part is a penis which is elongate and abruptly terminated by a flat small surface where a tiny appendix could be seen. The sole of the foot is cream.

Operculum: (Fig. 10) Elongated, almost straight, with a terminal nucleus.

Radula: (Fig. 9) Obtained from a specimen with shell of 17.1 mm. It is formed by two rows of marginal elongate teeth which total 50 in number. The tooth is sharp pointed with a small barb less that one third of the total length; an internal callous resembling a bone can be seen at the centre. The tooth is rather small (LC/DR= 142) and neither rachidian nor lateral teeth are present.

Distribution: Only known from the Dakar area of Senegal although NOLF (2008) mentions one specimen from Ivory Coast ex "Atlantidae" expedition.

Remarks: This is a well known west African species with many bibliographic references. VON MALTZAN (1883, 119, pl. 3, fig. 1) described it as *Drillia* and this generic placement was to be followed by all subsequent authors to date. They includes TRYON (1884: 208, pl. 30, fig. 80), POWELL (1966) and ARDOVINI AND COSSIGNANI (2004: 37, 220, 221).

KNUDSEN (1956) had some problems with the species placement confusing specimens from Gorèe Bay with *Drillia ballista* von Maltzan, 1883. Recently NOLF (2008) has discussed this error and separated clearly *tripter* and *ballista* whilst again maintaining the generic assignment in *Drillia*.

POWELL (1966) noted some pertinent radula differences between the genera *Drillia* and *Crassispira* and we believe that he did not have the possibility to study the radula of *tripter* von Maltzan, 1883. He states that the genus *Drillia* bear a minute unicuspid central tooth with curved, comb-like lateral teeth behind the marginal ones whilst the genus *Crassispira* has only the marginal teeth. We must therefore conclude that the correct generic assignation for this species must be in *Crassispira* and not in *Drillia*.

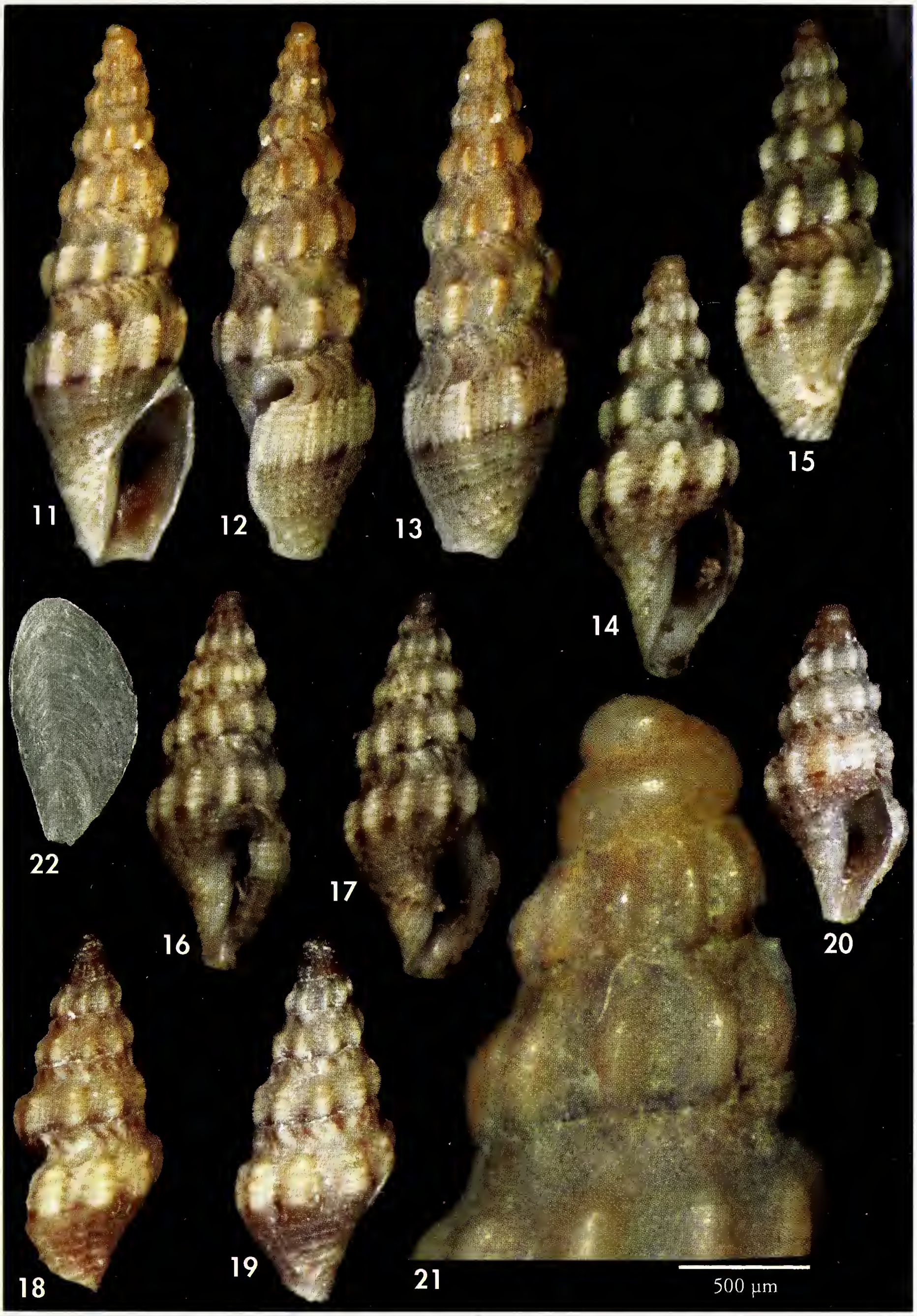
Crassispira trencarti spec. nov. (Figs. 11-22)

Type material: Holotype (Figs. 11-13), sp in MNHN (ex CAT). Paratypes from Petit Thiouriba, 30 m, basaltic rocks, Dakar, Senegal, in the following collections: 1 sp (Figs. 14, 15) in MNCN (ex CJP); 2 s (Figs. 16, 17) in CJP. All from the type locality; other paratype (Figs. 18, 19), 1 j (Fig. 20) in MHNS from N´Gor, 14 m.

Type locality: Off N'Gor Island, Dakar, Senegal, 37 m.

Etymology: Named after Mr. Alex Trencart, Paris, who in recent years dived extensively in the type locality and found the holotype.

Description: Shell (Figs. 11-20) fusiform elongate and solid with a high spire. Protoconch (Fig. 21) of a little more than one smooth and shiny light brown whorl with a diameter of about 700 μm. Teleoconch of the holotype with 6 ? whorls, which exhibit prominent axial ribs that are a little opisthocline in shape, which begin (except on the first two whorls) below a subsutural depressed area, finishing on the lower suture; on the last whorl the ribs fade below the periphery. Last whorl represents 40% of the total shell height, but in juvenile specimens the ratio can reach 50%; spiral sculpture of numerous small but prominent threads which continue up to the base. Aperture oval elongate, siphonal canal short and wide. Background colouration cream or light brown, with a narrow dark band on the suture; below this are irregularly spaced isolated oblique lines; on



Figures 11-21. *Crassispira trencarti* spec. nov. 11-13: holotype, 11.6 mm (MNHN); 14, 15: paratype, 7.8 mm (MNCN); 16, 17: paratype, 7.5 mm (CJP); 18, 19: paratype, 5.3 mm (MHNS); 20: paratype, 5.1 mm (MHNS); 21: protoconch of the holotype; 22: operculum.
Figuras 11-21. Crassispira trencarti *spec. nov. 11-13: holotipo, 11,6 mm (MNHN); 14, 15: paratipo, 7,8 mm (MNCN); 16, 17: paratipo, 7,5 mm (CJP); 18, 19: paratipo, 5,3 mm (MHNS); 20: paratipo, 5,1 mm (MHNS); 21: protoconcha del holotipo; 22: opérculo.*

the last whorl there is a cream band encompassing the widest part of the shell, bordered below by irregular but bold dark brown staining; the lower base is lighter and flecked with lighter and darker weak tubercules.

Dimensions: The holotype is 11.6 mm; the paratypes are smaller.

Animal: Not studied.

Operculum: (Fig. 22) Elongated with a terminal nucleus.

Distribution: Only known from the immediate area of Dakar, Senegal.

Remarks: *C. trencarti* spec. nov. was placed in the genus *Crassispira* because of the shell's general overall shape, the fact that the operculum has a terminal nucleus and it has close similarity to *Crassispira tripter* (von Maltzan, 1883).

Many of the other West African species are larger and wider and can easily be separated from the present species by the decollate spire. We comment on some similarly sized species from the area as follows:

Crassispira tripter (von Maltzan, 1883) is the closest species at first glance, however it is generally larger as already indicated, reaching more than 20 mm; it is also endemic to the area of Dakar and bears an elongate operculum with a terminal nucleus.

The protoconch of *C. tripter* is brown/mauve, depressed, bearing more numerous axial ribs on the teleconch and final whorls; the ribs are bold from the suture to the base and bend sharply to the left just above their midpoint; in the new species they only arise in a subsutural channel and drop perpendicular to the base. The general colour of the latter can be from light brown to orange to mauve/brown, often with some darker pattern on a lighter background just below the suture and again as a narrow band at the top of the aperture, below the widest part of the final whorl.

Crassispira laevisculcata (von Maltzan, 1883) is longer and narrower and lacks spiral cords; colour is lighter.

Crassispira consociata (E.A. Smith, 1877) is generally larger and decollate, lacking any dark colouration, and juvenile specimens exhibit a multispiral protoconch.

Crassispira sacerdotalis Rolán and Fernandes, 1992 is narrower, of a uniform colour and with an angular protoconch (Rolán and Fernandes, 1992 fig. 4).

Crassispira pini Fernandes, Rolán and Otero-Schmitt, 1996 is also endemic to the Dakar area where it is found intertidally under rocks. It is smoother, uniform dark-brown in colour with weaker, more numerous tubercles. Fernandes et al. (1995, fig. 28) illustrate a squat protoconch with strong radial lirations already in the third whorl which are quite different from our species.

Crassispira fuscobrevis Rolán, Ryall and Horro, 2007 can be of similar size with an intact protoconch but is endemic to south Angola, is stouter in shape and possesses a strong subsutural cord; the latter is generally uniform dark brown, or a little lighter in the subsutural area (i.e. the negative colour aspect of the species just described).

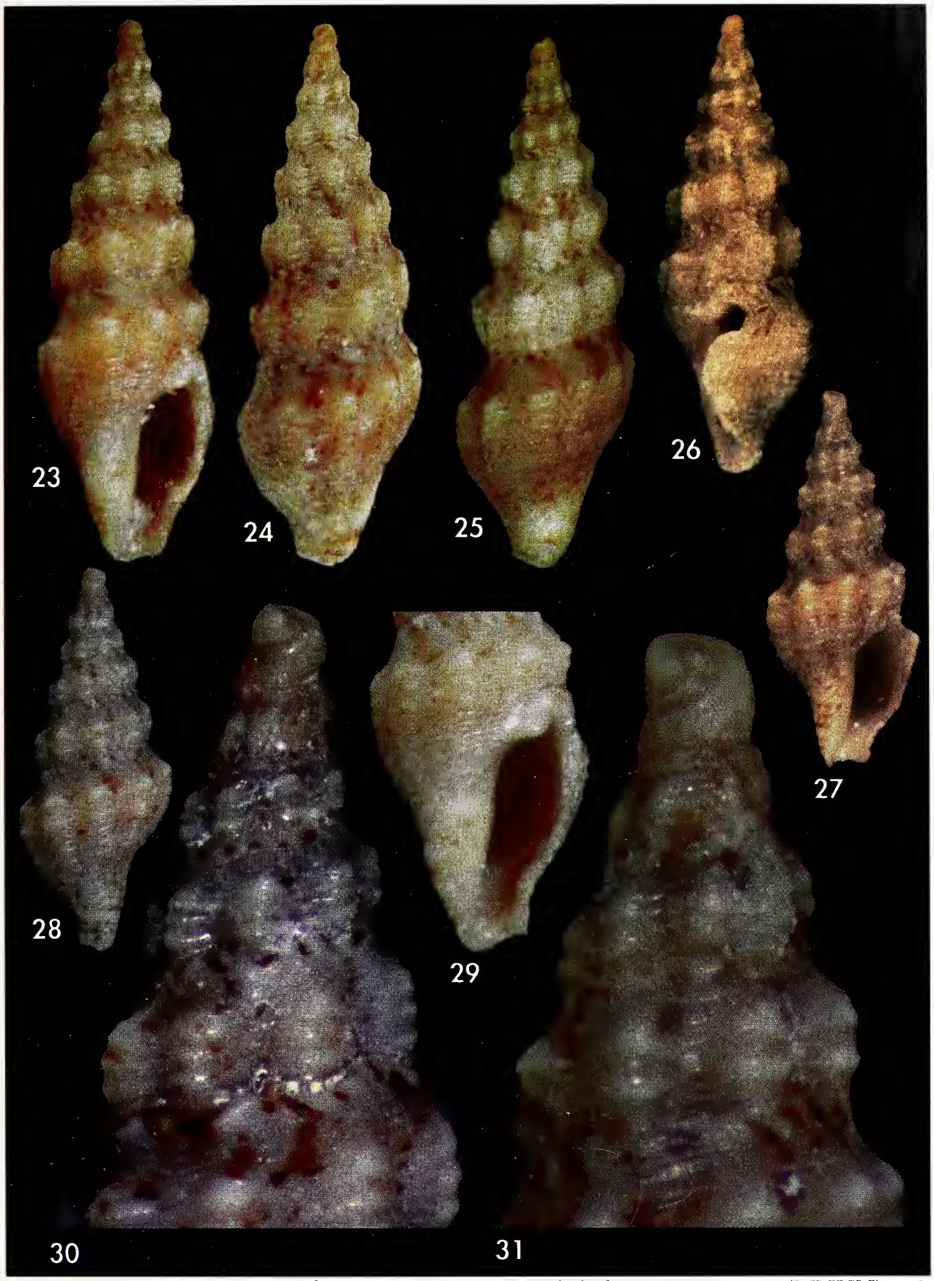
Addendum: After the submission of this paper, the authors obtained from Jacques Pelorce additional material of *Crassispira trencarti* spec. nov. and they were able to study its radula which confirms the generic atribution to *Crassispira* and the specific separation from *Crassispira tripter*. Both radular tooth are very similar, only different in the ratio, which in *Crassispira trencarti* has LC/DR = 133.

Crassispira sandrogorii spec. nov. (Figs. 23-31)

Type material: Holotype (Figs. 23, 24) in MNHN. Paratypes (all shells) in the following collections: MHNS (1, Figs. 27, 28) ; CPR (1, Fig. 14); CJH (1); and 4 more in CSG (Fig. 25, 26). All from the type locality.

Type locality: Minerio Reef, 00° 23′ 016″ N, 06° 46′ 228″ E, 43 m, on small rounded stones; São Tomé Island, Gulf of Guinea.

Etymology: Named after Mr. Sandro Gori, Italian malacologist, who in a recent collecting trip dived extensively in the type locality and collected all the material studied.



Figures 23-31. *Crassispira sandrogorii* spec. nov. 23, 24: holotype, 12.8 mm (MNHN); 25: paratype, 10.9 mm (CSG); 26: paratype, 10.5 mm (CPR); 27, 28 paratype, 8.2 mm (MHNS); 29: detail of the aperture, paratype (CSG); 30: detail of spire and protoconch, paratype (CSG); 31: protoconch, same paratype as Figure 28.

Figures 23-31. Crassispira sandrogorii *spec. nov. 23, 24: holotipo, 12,8 mm (MNHN); 25: paratipo, 10,9 mm (CSG); 26: paratipo, 10,5 mm(CPR); 27, 28 paratipo, 8,2 mm (MHNS); 29: detalle de la abertura, paratipo (CSG); 30: detalle de la espira y protoconcha, paratipo (CSG); 31: protoconcha, mismo paratipo que la Figura 28.*

Dimensions: The holotype is 12.8 mm, the paratypes are smaller.

Description: Shell (Figs. 23-28) fusiform elongate, with a high spire, solid, the whorls stepped. Protoconch (Figs. 30, 31) of one and a half smooth whorls, having a depressed nucleus and a peripheral angulation; its diameter is about 700 μm and the colour is light brown. Teleoconch of the holotype with 6-7 whorls, which exhibit prominent, wide and orthocline, or scarcely opisthocline, axial ribs, which (except on the first teleoconch whorls) begin below a subsutural depressed area, finishing on the lower suture; they are wider than their interspaces and on the last whorl fade below the periphery. The last whorl represents 40% of the total height, but in juveniles can reach 50% or more; spiral sculpture formed by numerous and well marked threads which continue up to the base. Aperture (Figs. 23, 29) oval elongate, with a prominent nodule on the upper part of the columella; siphonal canal short and wide, external lip fine with a deep sinus on the upper part, and strongly rounded anteriorly (Fig. 23). Background colouration yellowish-cream or light brown, with isolated dark narrow oblique axial lines irregularly scattered below the suture, and numerous dark spots appearing on the spiral thread on all the shell and down to the base.

Animal and operculum: Both are unknown.

Distribution: Only known from the type locality and we believe it is probably endemic to São Tomé Island or the immediate island group.

Remarks: Although the specimens examined have been collected without animal we have placed it in the genus *Crassispira* as the shape agrees well with other species of this genus.

Crassispira sandrogorii spec. nov. can be differentiated from all other West African species by the very distinct angulate protoconch. Only *Crassispira sacerdotalis* Rolán and Fernandes, 1992, which is also endemic to this island, has a similar protoconch, but it is smaller, much shorter and mauve/black as against honey brown in our new species. The spire is shorter, the axial nodules are weaker, the shell is monochromatic dark brown and smaller in size (8 – 10 mm)), the spire is much shorter, the axial nodules are weaker, and the shell is monochromatic mauve or black against honey brown in our new species.

Our species has some resemblance to *C. trencarti* spec. nov. in respect of the randomly scattered dark pigmentations but as mentioned the protoconch is quite distinct, the shoulder is less evident, the colour darker with spiral bands, the spiral sculpture is finer and has more numerous threads.

ACKNOWLEDGEMENTS

We are grateful to Alex Trentcart (Paris), Sandro Gori (Livorno), Jacques Pelorce (Paris), Frank Boyer (Sevran) and José María Hernández Otero (Gáldar, Canaries) who are all amateur conchologists and have allowed us to examine their material, and to Thomas Von Rintelen from Berlin Museum, who kindly sent us on loan the type material of *Crassispira tripter* (von Maltzan, 1883).

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Dendrodoris limbata (Cuvier, 1804)
Sinonimias
Doris limbata Cuvier, 1804, *Ann. Mus. Hist. Nat. Paris*, 4 (24): 468-469 [Localidad tipo: Marsella].
Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop.-Car.*, 10: 275.

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Ros J. 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoológica*, 3 (5): 21-51.

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Synonyms

Doris limbata Cuvier, 1804, *Ann. Mus. Hist. Nat. Paris*, 4 (24): 468-469 [Type locality: Marseille].

Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop.-Car.*, 10: 275.

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Fretter V. and Graham A. 1962. *British Prosobranch Molluscs*. Ray Society, London, 765 pp.

Ponder W.F. 1988. The Truncatelloidean (= Rissoacean) radiation - a preliminary phylogeny. In Ponder W.F. (Ed.): Prosobranch Phylogeny. *Malacological Review*, suppl. 4: 129-166.

Ros J. 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoológica*, 3 (5): 21-51.

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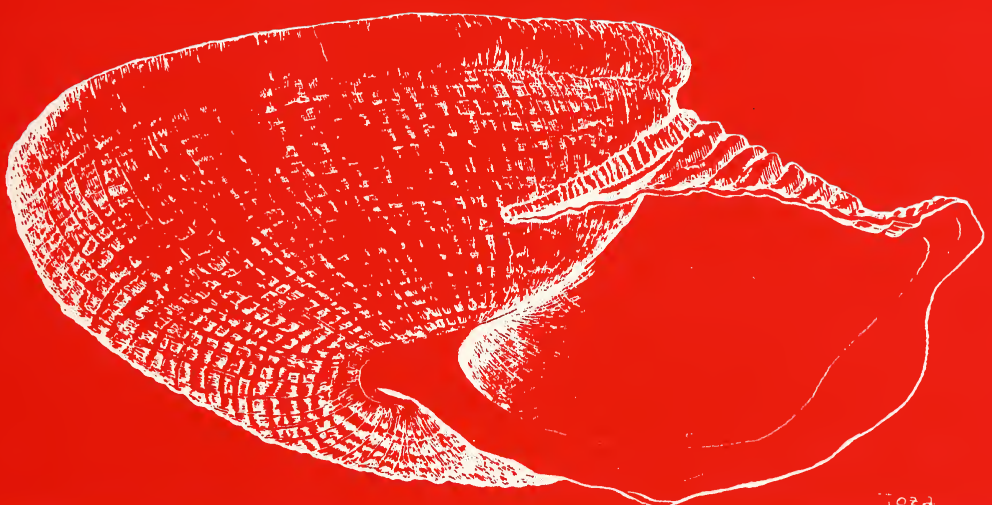

Oviedo, diciembre 2009

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Revista de la

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PORTADA DE *Iberus*

Iberus gualtieranus (Linnaeus, 1758), una especie emblemática de la península Ibérica, que da nombre a la revista. Dibujo realizado por José Luis González Rebollar "Toza".

Iberus

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A new species of *Lauria* (Gastropoda, Lauriidae) from the Canary Islands

Una nueva especie de *Lauria* (Gastropoda, Lauriidae) de las Islas Canarias

David T. HOLYOAK* and Geraldine A. HOLYOAK*

Recibido el 6-IV-2009. Aceptado el 23-VI-2009

ABSTRACT

A new species of *Lauria* is described from La Gomera, Canary Islands, where it coexists with *L. fanalensis* (R.T. Lowe, 1852) on trunks of trees in the laurel forests. The differences in their adult and especially juvenile shells are described and figured.

RESUMEN

Se describe una nueva especie de *Lauria* de La Gomera, Islas Canarias, en donde coexiste con *L. fanalensis* (R.T. Lowe, 1852) en troncos de árboles de la laurisilva. Se detallan e ilustran las diferencias en su morfología adulta y particularmente en sus conchas juveniles.

INTRODUCTION

Three species of the genus *Lauria* are recognised in Macaronesia and three in Europe (PILSBRY, 1922-1926; ZILCH, 1985; FALKNER, BANK AND VON PROSCHWITZ, 2001; BANK, GROH AND RIPKEN, 2002). Of these, the rather variable *L. cylindracea* (Da Costa, 1778) occurs not only in the Canary Islands, Madeiran Islands and the Azores, but also over much of western and southern Europe and in north-west Africa. The Macaronesian endemic *L. fanalensis* (R.T. Lowe, 1852), known from Madeira and the Canary Islands, resembles a small form of *L. cylindracea*, with weak apertural teeth and less thickened peristome. The Azores endemic *L. fasciolata* (Morelet, 1860) is more distinctive, so that it is now segregated in subgenus *Senilauria* Pilsbry, 1928. *L. sempronii* (Charpentier, 1837) occurs in western and southern Europe, eastwards to Iran and southwards to northern Algeria. The poorly known *L. reischuetzi* Falkner, 1985 has been found only in river floodline debris in Istra (Slovenija); it is apparently allied to *L. sempronii* and it may be a localised endemic species that lives underground (FALKNER, 1985). WOLLASTON (1878) noted that *fanalensis* 'may be only a depauperated state' of *L. cylindracea*, but he treated it as distinct because of differences in their shells and habitats, with *fanalensis* occurring mainly on tree trunks in laurel forests at intermediate to high elevations ('damp sylvan districts of a high altitude') whereas *cylindracea* 'is emphatically an inhabitant of the dry and cultivated districts, abounding more and more as we descend to the level of the sea'. Nevertheless, several populations we have

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studied from the Canary Islands (La Palma, 2; La Gomera, 1) are intermediate in shell size and morphology between *L. fanalensis* and *L. cylindracea* and they appear to intergrade rather than coexist. During fieldwork in the Canary Islands in February 2006 numerous specimens of *Lauria* were collected from tree trunks at two localities in laurel forest at 1100-1250 m elevation on La Gomera. These were assumed to all be of *L. fanalensis*, until later microscopic study revealed that two rather similar species were present in approximately equal numbers, living together at both localities. One of these is typical *L. fanalensis*, the other which is apparently undescribed is named in this paper. Its adult shells show only rather subtle differences from those of *L. fanalensis*, but the juvenile shells are markedly different. A recent molecular study (Renker, 2007) has revealed a pattern of genetic differentiation in european *L. cylindracea* that is not reflected in shell differences. A fuller study involving molecular techniques may therefore be necessary to elucidate the relationships of Macaronesian *L. cylindracea*, *L. fanalensis* and the new species.

TAXONOMIC PART

Family Lauriidae Steenberg, 1925
Genus *Lauria* J.E. Gray, 1840
Subgenus *Lauria*

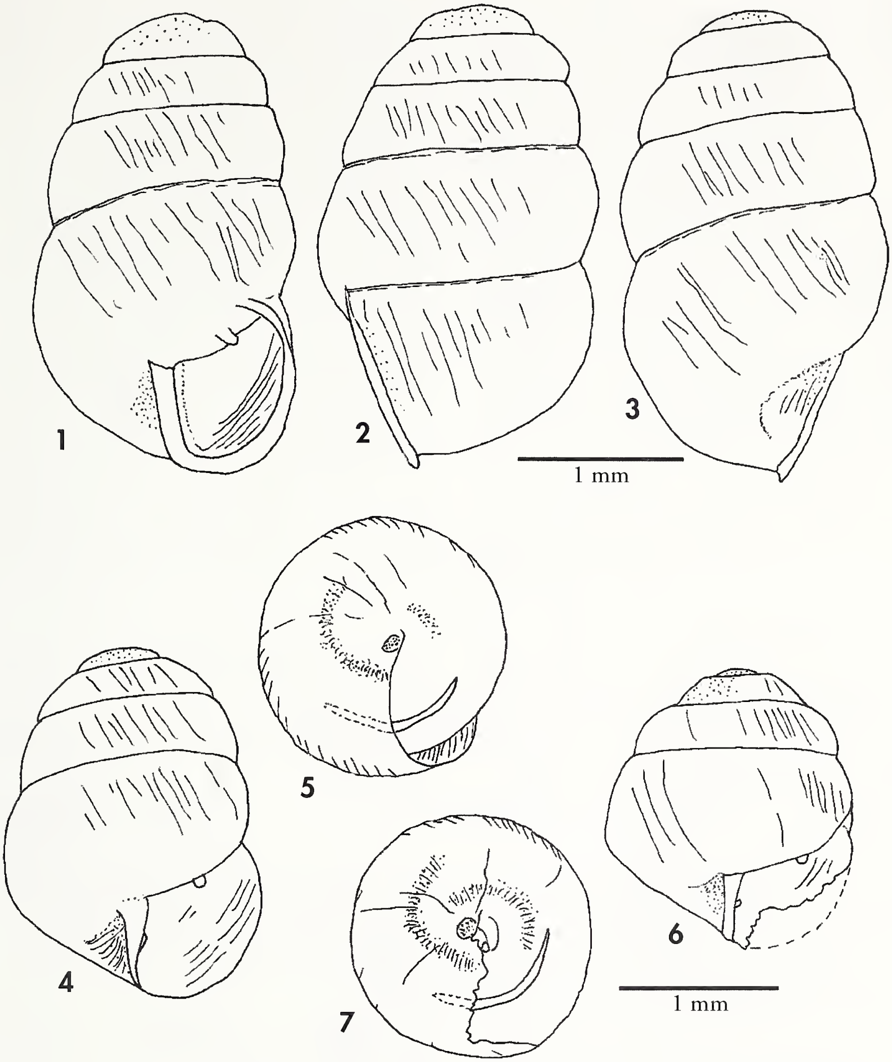
Type species: *Pupa umbilicata* Draparnaud, 1801 = *Turbo cylindraceus* Da Costa, 1778.

Remarks: Allocation of the genus *Lauria* to the Lauriidae rather than Pupillidae and recognition of subgenera follows Bank, Bouchet, Falkner, Gittenberger, Hausdorf, von Proschwitz and Ripken (2001), Bank *et al.* (2002) and Falkner *et al.* (2001).

Lauria gomerensis spec. nov. (Figs. 1-7)

Type material: From type-locality, adult holotype (Figs. 1-3; in the BM, reg. no. 20090224) and two juvenile paratypes (Figs. 4-7; in the BM, reg. nos. 20090225, 20090226); 15 adult and 3 juvenile paratypes in Collection of G.A. Holyoak; 1 adult and 1 juvenile paratypes in Collection of Dr Heike Kappes, University of Cologne, Germany. 9 adult paratypes from different locality (La Gomera: *ca* 1 km E. of Las Hayas, 28R 02756/31139, *ca* 1100 m alt., tree trunks in tall old laurel forest, leg. G.A. and D.T. Holyoak, 15 Feb. 2006, site G16) in Collection of G.A. Holyoak
Type locality: La Gomera, Islas Canarias, Spain: Cabezo del Pajarito (E. of Garajonay), 28R 02800/31113, *ca* 1250 m alt., tree trunks in shallow valley in laurel forest, leg. G.A. and D.T. Holyoak, 13 Feb. 2006, site G9.
Etymology: The specific epiphet is derived from the name of the island of La Gomera.

Description: Adult shell (Figs. 1-3) ovoid, of 5-6 moderately convex whorls, the body whorl lacking a basal keel, the mouth rounded. Peristome slightly thickened, sharply reflected, flattened and whitish. Parietal area lacking any callus. Angular tooth small, whitish, not joined to peristome and not prolonged into mouth; columellar tooth lacking. Juvenile shells (Figs. 4-7) with only slight marginal keel; slender angular tooth prolonged inside mouth as low narrow ridge extending for about one-third of whorl; slender columellar tooth prolonged inwards for short distance; largest whorl lacking thickened transverse palatal bars. Shell light brown, translucent, very glossy, with only rather faint growth ridges; protoconch very faintly punctate.

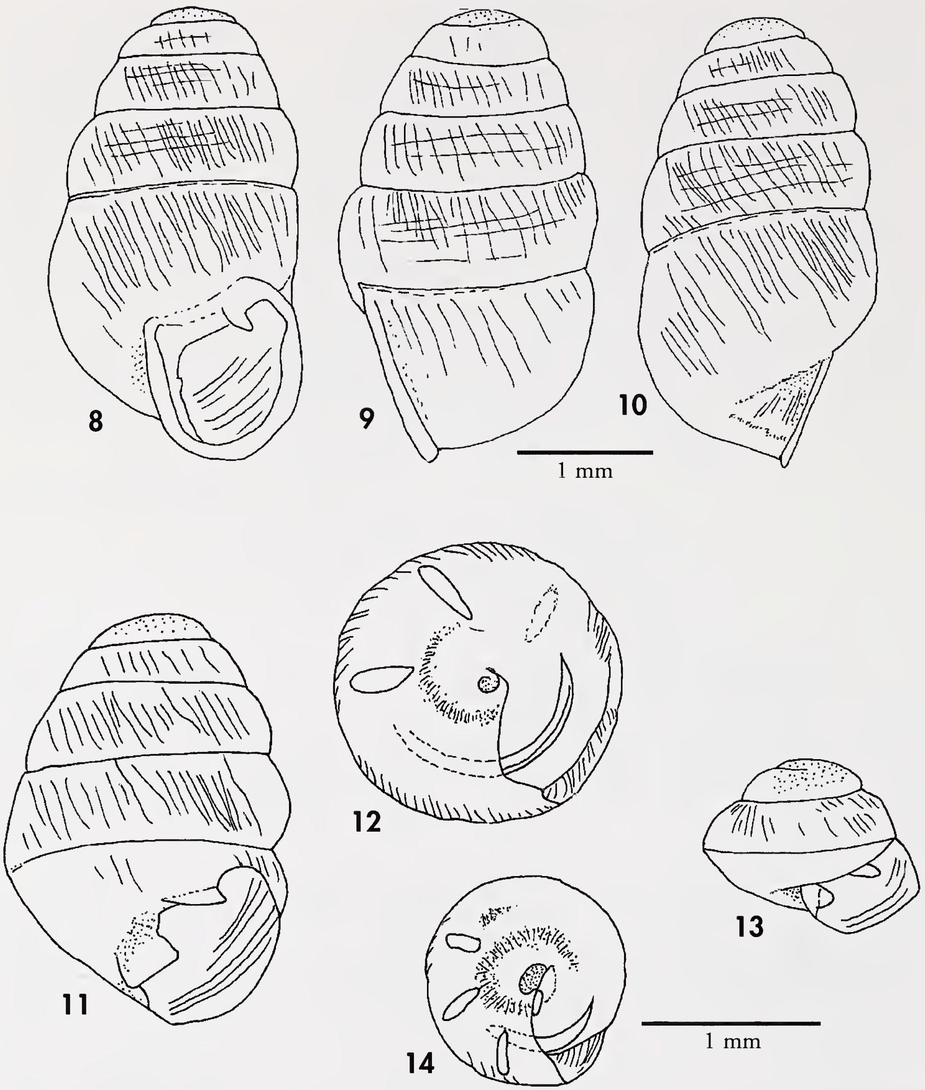


Figures 1-7. *Lauria gomerensis*. 1-3: holotype, adult shell, 2.85 mm (BM 20090224); 4, 5: paratype, juvenile shell, 2.15 mm (BM 20090225); 6, 7: paratype, juvenile shell, 1.7 mm (BM 20090226).

Figuras 1-7. Lauria gomerensis. *1-3: holotipo, concha adulta, 2,85 mm (BM 20090224); 4, 5: paratipo, concha juvenil, 2,15 mm (BM 20090225); 6, 7: paratipo, concha juvenil, 1,7 mm (BM 20090226).*

Dimensions: holotype 2.85 × 1.7 mm, 25 adult paratypes 2.5-3.1 × 1.5-1.7 mm.

Distribution and habitat: Collected from two localities at 1100-1250 m altitude on the island of La Gomera (see above). At both sites it was found only on vertical bark of the smooth trunks of a small minority of laurel forest trees (saplings to old trees, of a species of Lauraceae and *Ilex* sp.), mainly 1.0-2.5 m above the ground, on bark overhung by pendent mats or wefts of bryophytes



Figures 8-14. *Lauria fanalensis*. 8-10: adult shell, 3.15 mm (specimen in Collection of G.A. Holyoak; from La Gomera, Islas Canarias, Spain: Cabezo del Pajarito (E. of Garajonay), 28R 02800/31113, *ca* 1250 m alt., tree trunks in shallow valley in laurel forest, leg. G.A. and D.T. Holyoak, 13 Feb. 2006, site G9); 11, 12: juvenile shell, 1.4 mm; 13, 14: juvenile shell, 1.05 mm (both specimens in Collection of G.A. Holyoak; from La Gomera, Islas Canarias, Spain: Cabezo del Pajarito (E. of Garajonay), 28R 02800/31113, *ca* 1250 m alt., tree trunks in shallow valley in laurel forest, leg. G.A. and D.T. Holyoak, 13 Feb. 2006, site G9).

Figuras 8-14. Lauria fanalensis. *8-10: concha adulta, 3,15 mm (ejemplar en colección de G.A. Holyoak; de La Gomera, Islas Canarias, España: Cabezo del Pajarito (E. de Garajonay), 28R 02800/31113,* ca *1250 m alt., troncos de árboles en valle poco profundo en la laurisilva, leg. G.A. y D.T. Holyoak, 13 feb. 2006, sitio G9); 11, 12: concha juvenil, 1,4 mm; 13, 14: concha juvenil, 1,05 mm; barra de escala 2 mm (ambos ejemplares en colección de G.A. Holyoak; de La Gomera, Islas Canarias, España: Cabezo del Pajarito (E. de Garajonay), 28R 02800/31113,* ca *1250 m alt., troncos de árboles en valle poco profundo en la laurisilva, leg. G.A. y D.T. Holyoak, 13 feb. 2006, sitio G9).*

(particularly robust pleurocarpous mosses including *Neckera* sp.). It was accompanied in the same microhabitat by similar numbers of *L. fanalensis*, frequent *Columella microspora* (R.T. Lowe, 1852) a few individuals of *Hemicycla laurijona* (Alonso and Ibañez, 2007) and rare individuals of a *Napaeus* sp. *Remarks*: Shells of *L. gomerensis* have been compared with those of *L. fanalensis* living with it (Figs. 8-14) and from elsewhere in the Canary Islands (in Collection of G.A. Holyoak) and numerous topotypes from Madeira (BM). The adult shells of *L. gomerensis* differ in being smaller with more swollen whorls, stronger gloss on the periostracum, fainter lines of growth, lack of a columellar tooth and lack of any parietal callus. Immature shells of these two species differ more conspicuously because the strong transverse palatal bars inside the largest whorl of *L. fanalensis* (and *L. cylindracea*) visible through the translucent shell wall (Figs. 12, 14) are completely lacking in *L. gomerensis* (Figs. 5, 7). Other differences in the juvenile shells are the much more strongly keeled periphery of the body whorl in *L. fanalensis* and the stronger development of its angular and columellar teeth, which form higher whitish ridges that are prolonged further back inside the mouth.

L. gomerensis might be endemic in the laurel forest of La Gomera. Numerous specimens collected by the authors from similar habitats on La Palma (6 localities) and Teneriffe (3 localities) in 2002 and 2006 are all *L. fanalensis* (or intermediate between that species and *L. cylindracea*), as are museum specimens from Madeira (BM).

ACKNOWLEDGEMENTS

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Las náyades de la península Ibérica

As náiades da Península Ibérica

The naiads of the Iberian Peninsula

Rafael ARAUJO[1], Joaquim REIS[2], Annie MACHORDOM[1], Carlos TOLEDO[1], María José MADEIRA[3], Ignacio GÓMEZ[4], Juan Carlos VELASCO[5], Javier MORALES[6], José Miguel BAREA[7], Paz ONDINA[8] e Iker AYALA[9]

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RESUMEN

Se aporta información sobre la descripción original, sinonimias, taxonomía, distribución, morfología, ciclo vital, hábitat y estado de conservación de las diez especies de náyades (moluscos bivalvos de la superfamilia Unionoidea) nativas de la península Ibérica: *Margaritifera auricularia* (Spengler, 1793), *M. margaritifera* (L., 1758), *Potomida littoralis* (Cuvier, 1798), *Unio mancus* Lamarck, 1819, *U. gibbus* Spengler, 1793, *U. delphinus* Spengler, 1793, *U. tumidiformis* Castro, 1885, *U. ravoisieri* Deshayes, 1847, *Anodonta anatina* (L., 1758) y *A. cygnea* (L., 1758). Se restablece *Unio delphinus*, Spengler, 1793 como el nombre válido para la especie ibérica conocida hasta la fecha como *Unio pictorum* y se cita por primera vez la presencia de *Unio ravoisieri* Deshayes, 1847 en la península Ibérica.

Además se ilustran las conchas y detalles anatómicos de todas las especies, incluyendo, cuando se conoce, la forma y dimensiones de sus gloquidios así como información sobre los peces hospedadores de los mismos.

También se aportan las recomendaciones que, como expertos, consideramos deben llevarse a cabo por parte de las autoridades encargadas de la gestión de la biodiversidad para garantizar la conservación futura de las especies de este grupo animal tan amenazado.

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RESUMO

Disponibiliza-se informação sobre a descrição original, sinonímias, taxonomia, distribuição, morfologia, ciclo de vida, habitat e estado de conservação das dez espécies de náiades (moluscos bivalves pertencentes à superfamília Unionoidea) nativas da Península Ibérica: *Margaritifera auricularia* (Spengler, 1793), *M. margaritifera* (L., 1758), *Potomida littoralis* (Cuvier, 1798), *Unio mancus* Lamarck, 1819, *U. gibbus* Spengler, 1793, *U. delphinus* Spengler, 1793, *U. tumidiformis* Castro, 1885, *U. ravoisieri* Deshayes, 1847, *Anodonta anatina* (L., 1758) e *A. cygnea* (L., 1758). Se recupera *Unio delphinus*, Spengler, 1793 como o nome válido para a espécie ibérica conhecida até agora como *Unio pictorum* e se cita pela primeira vez a presença da *Unio ravoisieri* Deshayes, 1847 na Península Ibérica.

Também se ilustram as conchas e detalhes anatómicos de todas as espécies, incluíndo, quando se conhecem, a forma e dimensões dos seus gloquídios, assim como informação sobre os peixes hospedeiros dos mesmos.

Finalmente, são dadas recomendações sobre as acções que devem ser tomadas por parte das autoridades responsáveis pela gestão da biodiversidade, com vista a assegurar a conservação futura das espécies deste grupo animal tão ameaçado.

ABSTRACT

We make available information about the original description, synonyms, taxonomy, distribution, morphology, life cycle, habitat and conservation status of the ten species of native naiads (bivalve mollusks belonging to the superfamily Unionoidea) of the Iberian Peninsula: *Margaritifera auricularia* (Spengler, 1793), *M. margaritifera* (L., 1758), *Potomida littoralis* (Cuvier, 1798), *Unio mancus* Lamarck, 1819, *U. gibbus* Spengler, 1793, *U. delphinus* Spengler, 1793, *U. tumidiformis* Castro, 1885, *U. ravoisieri* Deshayes, 1847, *Anodonta anatina* (L., 1758) and *A. cygnea* (L., 1758). *Unio delphinus*, Spengler, 1793 is reinstated as the valid name for the Iberian species known hitherto as *Unio pictorum*, and the occurrence of *Unio ravoisieri* Deshayes, 1847 is reported for the first time in the Iberian Peninsula.

We also provide drawings of the shells and anatomical details of all species, and include information, when known, about the shape and dimensions of glochidia as well as about host fish.

Recommendations are given to authorities responsible for biodiversity management to ensure the conservation of this threatened animal group.

INTRODUCCIÓN

Las náyades o grandes bivalvos de agua dulce (Mollusca, Bivalvia, Unionoidea) se distribuyen por todo el mundo a excepción del continente antártico. Aunque todavía no se sabe con exactitud la verdadera diversidad del grupo, hoy se reconocen unas 840 especies repartidas del modo siguiente: 302 en el Neártico, 172 en la región Neotropical, 85 en la Afrotropical, 219 en la Indotropical, 45 en el Paleártico y 33 en Australasia (GRAF Y CUMMINGS, 2007). Una de las características principales de estos moluscos es su ciclo vital, ya que presentan un estado larvario singular en el reino animal; el más común es el denominado gloquidio, que requiere la presencia de un hospedador, en general un pez, en el que tras una metamorfosis se produce la fase juvenil. Es además frecuente la especificidad entre náyades y peces, de forma que no todas las especies de peces pueden actuar como hospedadoras de los gloquidios de todas las náyades. Ésta y otras razones (ver más abajo) pueden fácilmente explicar porqué las náyades están consideradas actualmente como uno de los grupos

animales más amenazado del planeta. En los Estados Unidos de América, donde las náyades tuvieron una radiación extraordinaria, más de la mitad de las especies están actualmente extinguidas, en peligro o amenazadas (LYDEARD, COWIE, PONDER, BOGAN, BOUCHET, CLARCK, CUMMINGS, FREST, GARGOMINY, HERBERT, HERSHLER, PEREZ, ROTH, SEDDON, STRONG Y THOMPSON, 2004). En Europa por su parte, la tasa actual de extinción de las poblaciones de las dos especies del género *Margaritifera* es catastrófica (ARAUJO Y RAMOS, 2001), y aunque no de forma tan grave o documentada, los otros géneros de náyades (*Unio, Potomida, Anodonta, Pseudanodonta, Mycrocondylaea*) están también en franca regresión.

Otra característica importante de las náyades es el papel que juegan en los ecosistemas de agua dulce donde viven, pudiendo afirmar que en un ecosistema sin modificar las náyades serían el grupo de animales con mayor biomasa (NEGUS, 1966). Intervienen además en la dinámica de los nutrientes de los sistemas acuáticos, removiendo fitoplancton, bacterias y materia orgánica del agua y sedimento y colaboran en la bioturbación de los fondos aumentando su contenido de oxígeno (STRAYER, CARACO, COLE, FINDLAY Y PACE, 1999; VAUGHN, NICHOLS Y SPOONER, 2008). Dado que una náyade del tamaño de *Margaritifera margaritifera* (L.) filtra hasta 50 litros diarios de agua, y que estas especies han vivido en colonias de hasta 700 ejemplares por metro cuadrado, en ese tramo de río se filtrarían 35.000 litros por día. Son además especies con un alto poder bioindicador, lo que probablemente ha querido reflejar el nombre de náyade, ya utilizado por el Caballero Jean-Baptiste Lamarck (1744-1829) para referirse a estos bivalvos, en referencia a las hadas o ninfas que mantienen la pureza de las aguas dulces. De este modo, la presencia (o la desaparición documentada) de poblaciones reproductoras (con ejemplares juveniles) de estos moluscos, puede ser de gran utilidad para conocer cambios en el estado de calidad y conservación de las aguas superficiales, lo que hace de las náyades excelentes especies centinelas.

Una tercera razón que aumenta el interés biológico de las náyades es su antigüedad en el registro fósil. Algunos autores consideran el origen del grupo en el Paleozoico, hace más de 350 millones de años (ver SIMPSON, 1900; WATTERS, 2001 y GRAF Y CUMMINGS, 2006), y recientemente se han descrito especies de los géneros *Margaritifera, Protopleurobema* y *Protoanodonta* del Mesozoico (Cretácico) de la península Ibérica (DELVENE Y ARAUJO, 2009a, b). Se trata por tanto de animales del máximo interés para estudios de procesos evolutivos a lo largo del tiempo y del espacio, por lo que podemos asegurar, junto con GRAF Y CUMMINGS (2006), que la filogenia de las náyades debe reflejar la influencia de procesos como la ruptura y separación de Pangaea en el Mesozoico, así como la evolución de las cuencas hidrográficas durante el Terciario hasta las últimas glaciaciones del Pleistoceno.

El primer trabajo dedicado a las náyades de la península Ibérica es de MORELET (1845), que cita la presencia de 13 especies en Portugal, de las que 8, que además se ilustran, son consideradas nuevas para la ciencia. Más tarde, DROUET (1893), utilizando también la taxonomía propia de la época, es decir la de la Nouvelle École francesa, cita, esta vez sólo para España, 48 especies y describe e ilustra 18 como nuevas. Según HAAS (1917a), ninguno de estos dos trabajos, ni el posterior de LOCARD (1899), pueden utilizarse directamente sin adaptación a los puntos de vista modernos. Lo mismo podría decirse de los trabajo de CASTRO (1873, 1885, 1887) sobre la fauna malacológica de Portugal. No obstante lo dicho, las localidades que estos autores citan, así como las ilustraciones de los ejemplares, siempre de una gran belleza, aportan una información de gran utilidad para la recopilación de datos antiguos sobre las náyades peninsulares. De este modo, no es hasta la segunda década del siglo XX cuando se hace el primer intento moderno de estudio de todas las

náyades de la península Ibérica incluyendo tanto Portugal como España (HAAS, 1917a). Aunque en esa época todavía no se disponía de datos completos sobre la distribución de las náyades ibéricas, sí se asumía la urgente necesidad de dar un primer paso para su estudio (HAAS, 1917a). En el mencionado trabajo, Haas, quizá el autor que mayores esfuerzos ha dedicado al estudio de la sistemática de las náyades, presenta unas exhaustivas notas bibliográficas en las que resume la siguiente información: 1. La relación cronológica de todos los trabajos sobre náyades ibéricas con indicación de las especies mencionadas en cada uno (lista I). 2. La relación crítica con la equivalencia entre las especies citadas en la lista I y los nombres aceptados en la época (lista II). 3. La relación de citas geográficas de las especies (lista III). Concluye HAAS (1917a) que las 161 especies ibéricas de náyades citadas en todos los trabajos de la lista I pueden reducirse a las 7 siguientes (Haas refiere los autores sin paréntesis): *Anodonta cygnea* L., *Unio turtoni* Payraudeau, *Unio delphinus* Spengler, *Unio batavus* Lam., *Rhombunio littoralis* Lam., *Margaritifera auricularia* Spengler y *Margaritifera margaritifera* L.

Otro trabajo exhaustivo en el que se consideran las especies de bivalvos ibéricas es el de AZPEITIA (1933), que aunque no propone un análisis crítico de la taxonomía del grupo, sí aporta un pormenorizado estudio de la bibliografía y las citas correspondientes a las náyades de España y Portugal. NOBRE (1912, 1930, 1941) por su parte, revisa la fauna de náyades de Portugal, aportando nueva información y revisando la bibliografía. Su publicación de 1941 no aporta nuevos datos con respecto a sus anteriores obras, pero sí reduce la lista de especies de Portugal a las 4 siguientes: *Margaritana margaritifera*, *Unio pictorum* (L., 1757), *Unio littoralis* Lamarck, 1835 y *Anodonta cygnea.*

A partir de estos trabajos no existe ya ninguna nueva referencia bibliográfica que revise o que aporte datos críticos o contrastados sobre las especies ibéricas, salvo una clasificación tentativa sobre los Unionoideos paleárticos (Haas, 1940) en la que ya se adivina la futura monografía que el mismo autor publicaría (HAAS, 1969) justo antes de su muerte. En ese trabajo, HAAS (1940) ya presentaba las ideas "modernas" de su maestro Kobelt, según el cual una clasificación natural de las náyades debía tener en consideración su distribución en las diferentes cuencas hidrográficas, apuntando por primera vez la importancia del efecto de aislamiento de las especies producido por las fronteras hidrográficas. Se cita también en este artículo por primera vez para las náyades el concepto de "subespecie" o "raza local", que sería la base de la clasificación sistemática que propondría posteriormente. La monografía de HAAS (1969) supuso así un trabajo exhaustivo de revisión de colecciones y bibliografía en el que se aportan las sinonimias (cientos en el caso de algún taxon) de todas las especies de náyades mundiales consideradas por el autor. En dicha monografía, que junto con la de SIMPSON (1900) se ha considerado por los especialistas como el punto de partida moderno sobre la sistemática de la Superfamilia Unionoidea, Haas consideró la existencia de una serie de especies fundamentales cada una de las cuales englobaba diferentes "razas locales" o "especies incipientes". Por ejemplo, dentro de la "especie fundamental" *Unio pictorum*, Haas incluía 13 taxa (razas locales o subespecies) diferentes con sus respectivas distribuciones geográficas, a las que distinguía añadiendo un tercer nombre después de *pictorum* que correspondía con el nombre de la especie con el que ese taxon había sido descrito. Así, consideraba *U. p. delphinus* como subespecie diferente de la otra subespecie ibérica *U. p. mucidus.* Como ya se ha comentado, para definir estas razas o subespecies HAAS (1969) continuó las ideas de Kobelt sobre la sistemática de las náyades. Para ello, utilizó principalmente la forma de la concha y su variabilidad, de modo que cada subespecie es más fácil de distinguir en los centros que en los bordes de sus áreas de distribución. Con respecto a

la península Ibérica, Haas (1969) consideró la presencia de los siguientes taxa: *M.* (*Margaritifera*) *margaritifera* (L.), *M.* (*Pseudunio*) *auricularia* (Spengler), *Unio pictorum mucidus* Morelet, *U. pictorum delphinus* Spengler, *U. elongatulus penchinatianus* Bourguignat, *U. elongatulus valentinus* Rossmässler, *U. crassus batavus* Maton y Racket, *Potomida littoralis littoralis* (Lamarck), *P. littoralis umbonata* (Rossmässler) y *Anodonta* (*Anodonta*) *cygnea* (L.). Para cada una de ellas citaba un área de distribución que, como se verá al hablar de cada especie, ha variado muy poco con las novedades taxonómicas aparecidas posteriormente. Esta clasificación, a veces con ciertas modificaciones, es la que se ha ido utilizando en todos los trabajos ibéricos posteriores en los que se han citado especies de náyades (Vidal Abarca y Suárez, 1985; Altaba, 1991; Bech y Altimiras, 2003; Pérez-Quintero, Bech y Huertas, 2004).

En la última década del siglo XX e inicio del XXI empieza a revisarse la taxonomía de las náyades ibéricas (Araujo y Ramos, 1998; Machordom, Araujo, Erpenbeck y Ramos, 2003; Araujo, Gómez y Machordom, 2005; Araujo, 2008; Araujo, Toledo y Machordom, 2009a; Reis y Araujo, 2009; Reis, Machordom y Araujo, en rev.), estudiando no sólo los caracteres habitualmente usados de morfología de la concha y anatomía, sino que se incluyen además caracteres moleculares, cuyo uso es ampliamente recomendado en la bibliografía especializada (Graf y Cummings, 2006), así como información sobre la biología de las especies (gloquidio, peces hospedadores, época de reproducción). El uso de estos caracteres, especialmente las secuencias de los genes mitocondriales CoI y 16S, ha permitido superar la subjetividad que hasta ahora atenazaba la taxonomía de las náyades, limitada al estudio de un carácter tan variable como es la forma de la concha, pudiendo así identificar linajes evolutivos muy claros. Gracias a estos estudios se han distinguido especies ibéricas como *Unio delphinus* Spengler, 1793 o *Unio tumidiformis* Castro, 1885 de sus especies gemelas europeas *Unio pictorum* (L.) y *Unio crassus* Philipsson, 1788, respectivamente. Estos estudios han coincidido en el tiempo con un renovado esfuerzo en el conocimiento de las áreas de distribución, biología y ecología de las diferentes especies (Álvarez-Claudio, García Rovés, Ocharán, Cabal, Ocharán y Álvarez, 2000; Araujo y Ramos, 2000a; Soriano, Villena y Alonso, 2001; Araujo, Bragado y Ramos, 2000, 2001; Grande, Araujo y Ramos, 2001; Velasco, Araujo, Bueno y Laguna, 2002; Araujo, Cámara y Ramos, 2002; Machordom *et al.*, 2003; Reis, 2003; Araujo, Quirós y Ramos, 2003; Morales, Negro, Lizana, Martínez y Palacios, 2004; Nagel, 2004; San Miguel, Monserrat, Fernández, Amaro, Hermida, Ondina y Altaba, 2004; Araujo *et al.*, 2005; Reis, 2006; Velasco y Romero, 2006; Velasco, Araujo, Balset, Toledo y Machordom, 2006; Bouza, Castro, Martínez, Amaro, Fernández, Ondina, Outeiro y San Miguel, 2007; López, Altaba, Rouault y Gisbert 2007; Outeiro, Ondina, Fernández, Amaro y San Miguel, 2008; Reis y Araujo, 2009; Reis *et al.*, en rev.).

Todos estos trabajos confirman la existencia en la península Ibérica de dos familias de náyades, Margaritiferidae y Unionidae, englobando la primera las especies del género *Margaritifera* y la segunda los géneros *Unio*, *Potomida* y *Anodonta*. Las dos familias tienen una muy amplia distribución en el mundo (Haas, 1969; Graf y Cummings, 2007; Bogan, 2008), caracterizándose la primera por ser un grupo probablemente relicto con solamente 10 especies vivas (Araujo, Toledo, Van Damme, Ghamizi y Machordom, 2009b).

También en la península Ibérica los unionoideos son actualmente uno de los grupos animales más amenazados de desaparición. Entre las causas fundamentales están la fragmentación y/o desaparición de sus hábitats (detracciones de agua, alteración de los caudales y flujos por las centrales hidroeléctricas y riegos, aumento exponencial de industrias

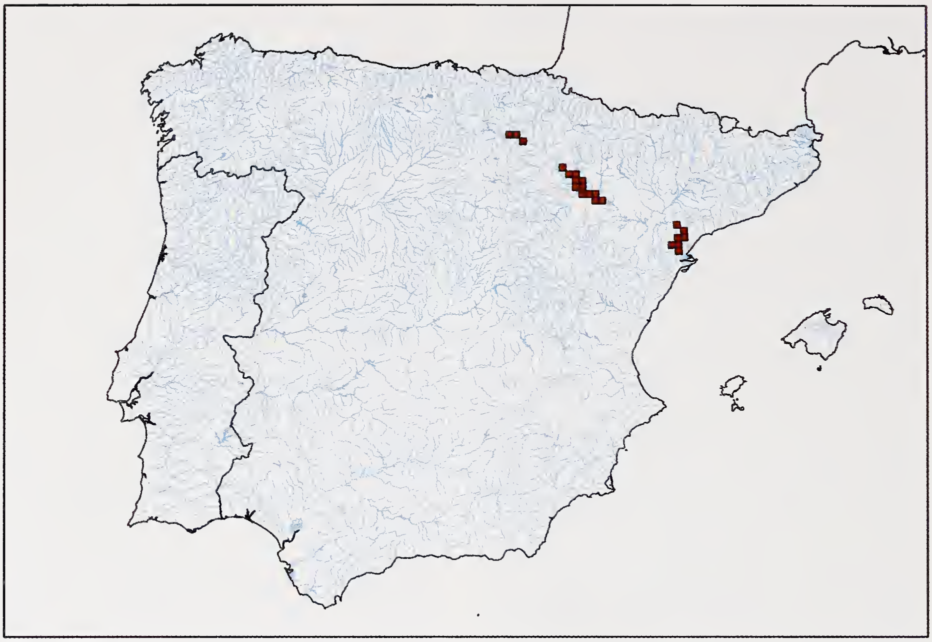


Figura 1. Distribución de *Margaritifera auricularia*.
Figura 1. Distribuição de Margaritifera auricularia.
Figure 1. Distribution map of Margaritifera auricularia.

contaminantes y cultivos), aunque otros factores como la presencia de especies de peces y bivalvos invasores también pueden estar jugando un papel importante (BOGAN, 1993; RICCIARDI, NEVES Y RASMUNSSEN 1998; LYDEARD *ET AL.*, 2004; STRAYER, DOWNING, HAAG, KING, LAYZER, NEWTON Y NICHOLS, 2004). Esta disminución en las poblaciones de náyades se ha visto ya en los ríos peninsulares (REIS, 2003; MORALES *ET AL.*, 2004; VELASCO Y ROMERO, 2006; VERDÚ Y GALANTE, 2006; BAREA, BALLESTEROS Y MORENO, 2008; GÓMEZ Y ARAUJO, 2008), por lo que se hace necesario poner en conocimiento de la sociedad y de las autoridades encargadas de la conservación de la biodiversidad lo que hoy sabemos sobre este grupo animal tan amenazado. Es por tanto del máximo interés dar a conocer tanto los nombres válidos como las distribuciones reales de las especies ibéricas de náyades.

En el presente trabajo pretendemos ofrecer una visión actualizada de dichas especies, su diversidad, variabilidad, adscripción taxonómica, distribución y estado de conservación. También sobre su biología y ecología, por lo que se incluyen datos, cuando se conocen, sobre el tipo de gloquidio, época de reproducción y peces hospedadores. Los mapas de distribución se han realizado situando las localidades en cuadrículas UTM de 10 x 10 km. La información que ilustran se refiere a presencia de ejemplares y/o poblaciones vivos en los últimos 20 años comprobada por los autores. Gran parte de este material está depositado en el Museo Nacional de Ciencias Naturales de Madrid. No se ha representado la presencia de valvas en playas o zonas de sedimentación.

Para obtener las listas de sinónimos se han utilizado sobre todo los trabajos de AZPEITIA (1933) y HAAS (1969). También se aporta información sobre dónde se pueden localizar las primeras o únicas ilustraciones de las especies, lo que ha sido de gran utilidad a la hora de

identificar alguna de ellas (ej. *U. gibbus*). En el caso de las dos especies de *Anodonta* se ha consultado la bibliografía recomendada por HANLEY (1855) para reconocer los tipos de Linneo, fundamentalmente LISTER (1678, 1685, 1770) y ROSSMÄSSLER (1835, 1836, 1837), así como SCHRÖTER (1779). La bibliografía en la que se pueden encontrar esas ilustraciones, así como las de los ejemplares tipo de cada especie, se cita de forma completa en los apartados de sinónimos y descripción original.

En alguno de los casos la información que se aporta es inédita; cuando es así, los conocimientos en los que se basa están en fase muy avanzada y se citan como datos sin publicar. Aunque recientemente citada en España (POU-ROVIRA, ARAUJO, BOIX, CLAVERO, FEO, ORDEIX Y ZAMORA, 2009), no hemos considerado la especie exótica *Anodonta* (= *Sinanodonta*) *woodiana* (Lea, 1834). En resumen, se trata de las siguientes 10 especies: *Margaritifera auricularia* (Spengler, 1793), *M. margaritifera* (L., 1758), *Potomida littoralis* (Cuvier, 1798), *Unio mancus* Lamarck, 1819, *U. gibbus* Spengler, 1793, *U. delphinus* Spengler, 1793, *U. tumidiformis* Castro, 1885, *U. ravoisieri* Deshayes, 1847, *Anodonta anatina* (L. 1758) y *A. cygnea* (L., 1758).

SISTEMÁTICA

Margaritifera auricularia (Spengler, 1793)

Sinónimos:

Unio sinuata Lamarck, 1819. *Anim. sans. vert.*, 6 (1): 70. Sintipo ilustrado en Valledor y Araujo, 2006. *Malacologia*, 48 (1-2): 286, fig. 1.

Unio margaritanopsis Locard, 1889. *Not. Conch.*, 13: 17. Ilustrado en Locard, 1893. *Conchyliologie Francaise*, 151, fig. 163 y en Valledor y Araujo, 2006. *Malacologia*, 48 (1-2): 291, fig. 15.

Descripción original: *Unio auricularius* Spengler, 1793. *Skrifter af Naturhistorie Selskabet, Kjobenhavn*, 3 (1): 54.

Localidad tipo: Este de la India. Sin duda un error (ver más abajo). Lectotipo en el Zoological Museum of the University of Copenhagen. Nº: ZMUC BIV-315.

Ilustrado en: Haas, 1913. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening I Kjobenhavn*, 65: 54, textfig. 1; Knudsen *et al.*, 2003. *Steenstrupia*, 27 (2): 267, fig. 3; Valledor y Araujo, 2006. *Malacologia*, 48 (1-2): 286, fig. 5. Las referencias ilustran el lectotipo.

Comentario taxonómico: Aunque según SPENGLER (1793) el ejemplar tipo procede del este de la India, esta especie sólo se conoce de Europa. Otro error de SPENGLER (1793) en la descripción de esta especie fue asignarle la ilustración de LISTER (1685-1692, figure 149, plate 4), ya que en realidad se trataba de una figura de *M. margaritifera* (HAAS, 1909; VALLEDOR Y ARAUJO, 2006).

HAAS (1910) describió el género *Pseudunio* para incluir a esta especie y así diferenciarla de *M. margaritifera*, pero *Pseudunio* fue posteriormente sinonimizado con *Margaritana* (=*Margaritifera*) por ORTMANN (1911). No obstante, *Pseudunio* ha sido más tarde usado como subgénero por HAAS (1969) para separar *M. auricularia* y su variedad *M. a. marocana* (Pallary, 1918) del resto de las especies del género. Más recientemente se ha vuelto a utilizar como género por SMITH (2001) y NIENHUIS (2003) para éstas y otras especies de la familia. Aunque los últimos estudios demuestran que *M. auricularia* y *M. marocana* son dos especies diferentes que forman un grupo monofilético o clado dentro de la familia (ARAUJO ET AL., 2009b), todavía no sabemos si deben considerarse diferentes subgéneros dentro de *Margaritifera* (HUFF, CAMPBELL, GUSTAFSON, LYDEARD, ALTABA Y GIRIBET, 2004). Como conclusión, proponemos no utilizar *Pseudunio* como género ni como subgénero para incluir a *M. auricularia* al menos hasta

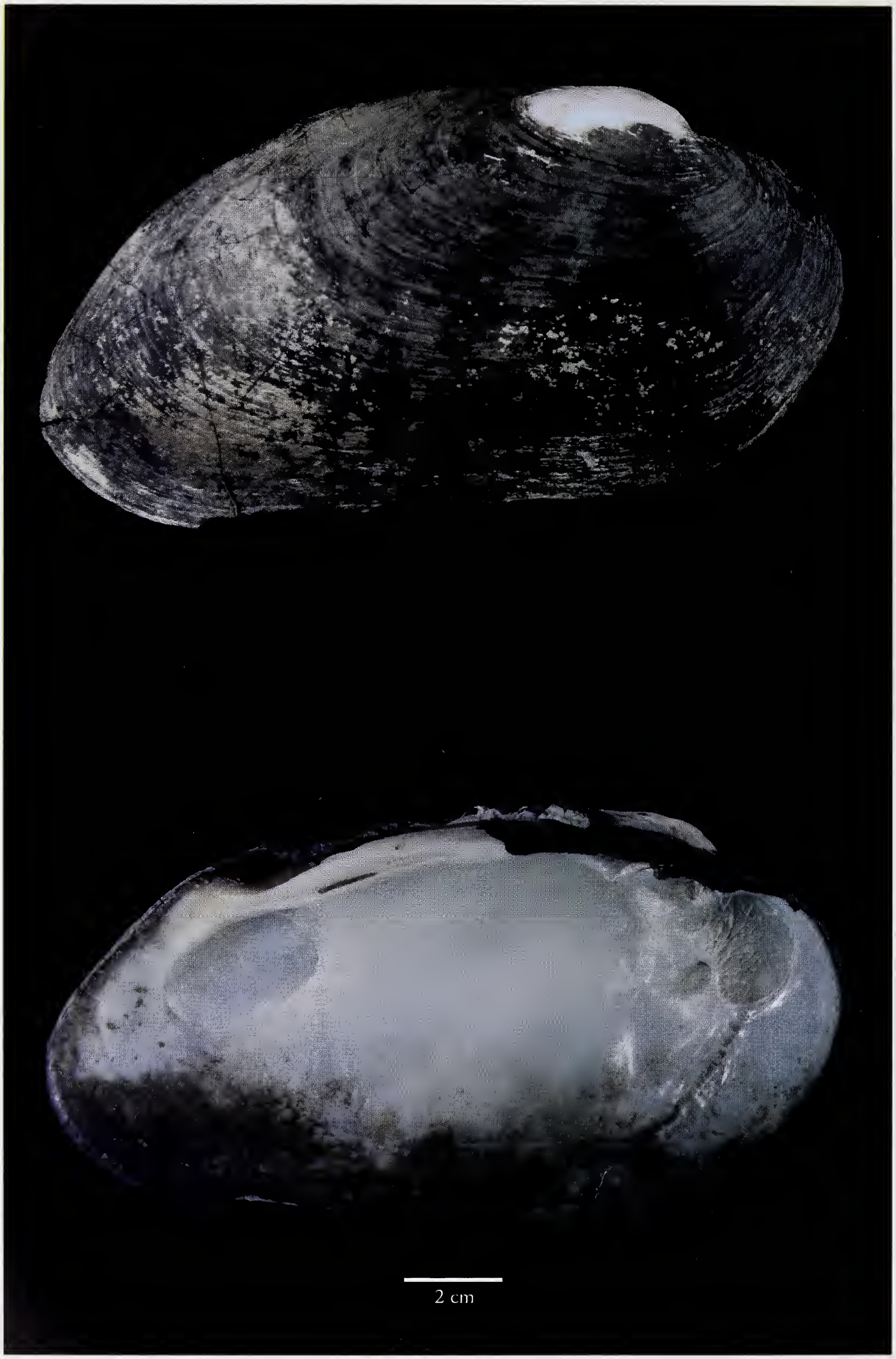


Figura 2. *Margaritifera auricularia*. Canal Imperial de Aragón en Grisén (Zaragoza).
Figura 2. Margaritifera auricularia. *Canal Imperial de Aragón em Grisén (Zaragoza).*
Figure 2. Margaritifera auricularia. *Canal Imperial de Aragón at Grisén (Zaragoza).*

Figura 3. *Margaritifera auricularia.* Río Ebro en Sástago (Zaragoza).
Figura 3. Margaritifera auricularia. *Rio Ebro em Sástago (Zaragoza).*
Figure 3. Margaritifera auricularia. *Ebro river at Sástago (Zaragoza).*

que no se obtenga una filogenia definitiva de la familia que así lo recomiende.

Distribución: Paleártico oeste. Extinguida en gran parte de su área de distribución (ALTABA, 1990; NESEMANN, 1993; ARAUJO Y MORENO, 1999; ARAUJO Y RAMOS, 2000a) a excepción del cauce principal del río Ebro en Aragón y Tarragona, Canales Imperial de Aragón y de Tauste (Fig. 1) (Aragón y Navarra) (ARAUJO Y RAMOS, 2000b; GÓMEZ Y ARAUJO, 2008) y ríos Loire y Charente en Francia (NIENHUIS, 2003). Actualmente, la población más numerosa del planeta parece ser la que vive en el Canal Imperial de Aragón, en la provincia de Zaragoza, con aproximadamente 3.500 ejemplares. Los datos publicados sobre la población del bajo Ebro (ALTABA, 1997) han sido obviamente sobreestimados, y todavía no se ha realizado una evaluación contrastada del número de ejemplares que viven en los ríos Charente y Loire. Existe una cita de 1903 del río Tajo en Toledo (AZPEITIA, 1933) y se han encontrado valvas de ejemplares muertos en las últimas décadas en el Ebro en Burgos, Álava, La Rioja y Navarra (ARAUJO, MADEIRA Y AYALA, 2007).

En los ríos de Marruecos vive una especie muy similar (*M. marocana*) que antes se consideraba sinónima de *M. auricularia*, pero recientemente se ha redescrito como especie diferente (ARAUJO *ET AL.*, 2009b).

Morfología externa (Figs. 2, 3 y 4): Concha negra, alargada y muy gruesa, a veces con silueta auriculada, especialmente en los ejemplares procedentes de ríos con fuerte corriente. Los adultos pueden alcanzar hasta 18 cm de longitud. Interior de las valvas blanco nacarado muy brillante. Charnela con dos dientes laterales posteriores en la valva izquierda y uno en la derecha, todos muy fuertes y alargados. Dientes pseudocardinales robustos y de aspecto piramidal, dos en la valva izquierda y uno en la derecha. Por su gran tamaño sólo podría confundirse con las especies de *Anodonta*, pero éstas presentan siempre conchas muy delgadas y frágiles y sin dientes en la charnela. Los ejemplares juveniles (Fig. 4), muy poco comunes, se distinguen de *Unio* y *Potomida* por la charnela y por ser mucho más aplastados.

En cuanto a su anatomía, y como el resto de las especies de la familia Margaritiferidae, presenta una serie de particularidades anatómicas (Fig. 5A) diferentes de las de la familia Unionidae: 1. las papilas del sifón inhalante son pequeñas y arborescentes, nunca cónicas. 2. carecen de abertura supraanal dorsal al sifón exhalante. 3. el diafragma que divide las cavidades infra y suprabranquial es incompleto y 4. las dos láminas de cada branquia en vez de estar unidas por tabiques continuos perpendiculares que forman tubos de agua están fusionadas por septos interlamelares distribuidos al azar.

Ciclo vital: Especie muy longeva (60-100 años). En la única población estudiada (Canal Imperial de Aragón) se ha observado que existe un elevado porcentaje de ejemplares hermafroditas (GRANDE, ARAUJO Y RAMOS, 2001) y que tiene un solo ciclo reproductivo al año (ARAUJO, BRAGADO Y RAMOS, 2000). Los gloquidios se liberan en febrero-marzo, miden 140 x 130 x 60 μm y carecen de ganchos (Fig. 6A), aunque sí presentan unos pequeños dientes en su borde ventral con los que se fijan a los filamentos branquiales de los peces hospedadores (ARAUJO Y RAMOS, 1998). A diferencia de la mayoría de las náyades, las especies del género *Margaritifera* incuban los gloquidios en las cuatro branquias.

Solamente se conocen dos peces nativos hospedadores de los gloquidios de *M. auricularia*, el esturión, *Acipenser sturio* L. y el pez fraile o blenio de río, *Salaria fluviatilis* (Asso), el primero extinguido en el Ebro y el segundo en peligro de extinción. En experimentos realizados en acuarios se ha visto que los gloquidios también se enquistan en las branquias de las especies exóticas de esturión *Acipenser baeri* Brandt y *A. naccarii* Bonaparte, dando lugar a náyades juveniles que miden 190 μm (ARAUJO Y RAMOS, 2000b; ARAUJO *ET AL.*, 2001, 2002, 2003; LÓPEZ *ET AL.*, 2007). También

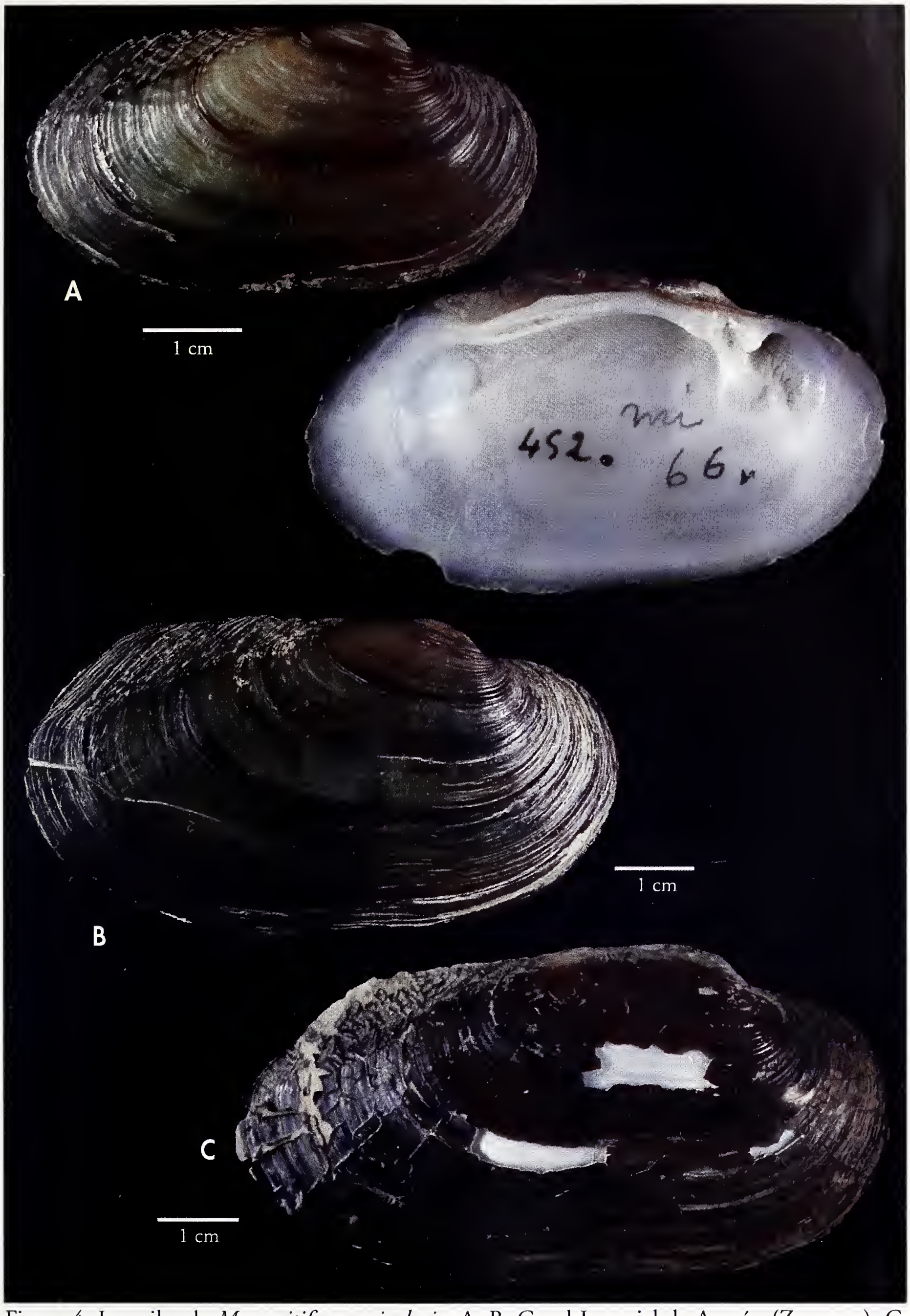


Figura 4. Juveniles de *Margaritifera auricularia.* A, B: Canal Imperial de Aragón (Zaragoza); C: Canal de Tauste (Navarra).
Figura 4. Juvenis de Margaritifera auricularia. *A, B: Canal Imperial de Aragón (Zaragoza); C: Canal de Tauste (Navarra).*
Figure 4. Juvenile shells of Margaritifera auricularia. *A, B: Canal Imperial de Aragón (Zaragoza); C: Canal de Tauste (Navarra).*

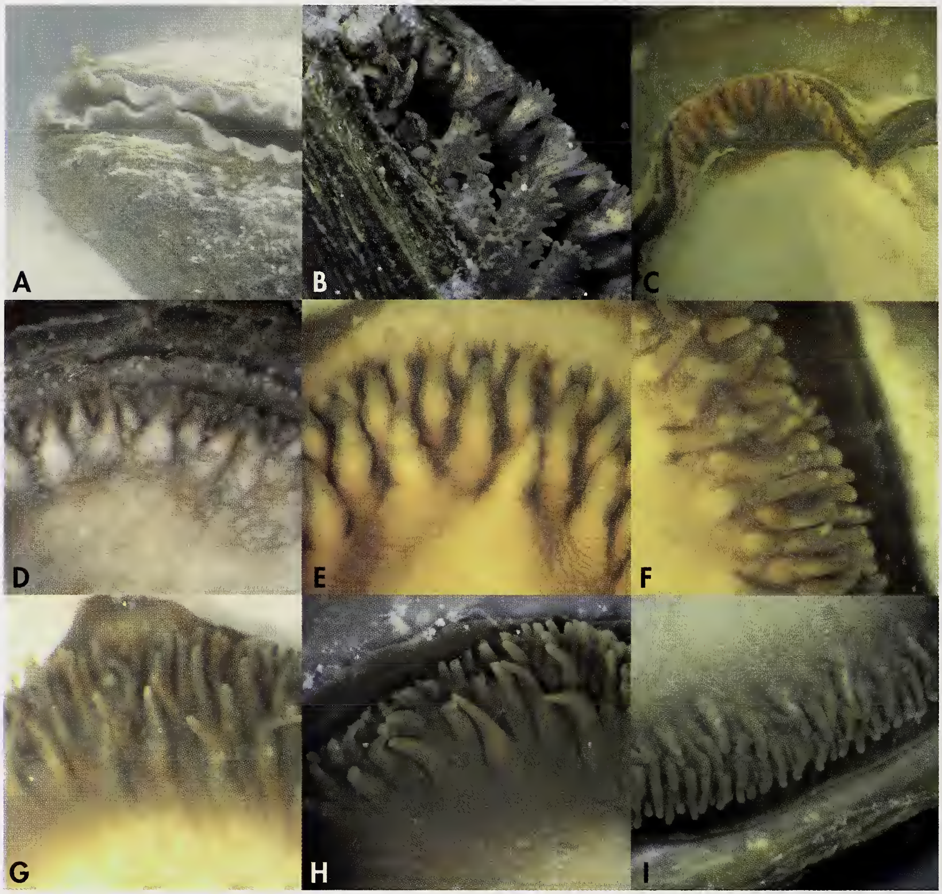


Figura 5. Sifones. A: *Margaritifera auricularia*; B: *M. margaritifera*; C: *Potomida littoralis*; D: *Unio mancus*; E: *U. delphinus*; F: *U. gibbus*; G: *U. tumidiformis*; H: *U. ravoisieri*; I: *Anodonta anatina.*

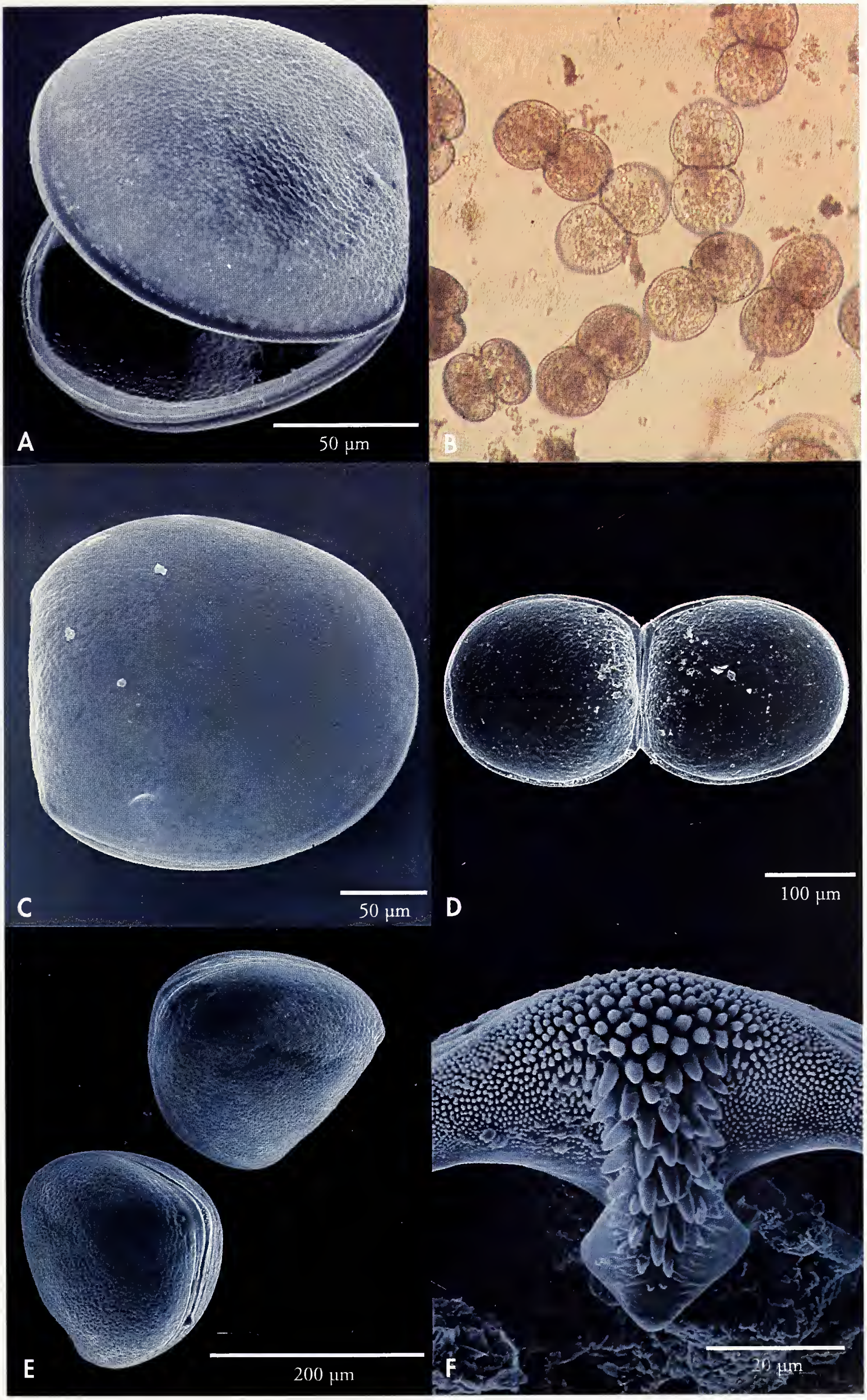
Figura 5. Sifões. A: Margaritifera auricularia*; B:* M. margaritifera*; C:* Potomida littoralis*; D:* Unio mancus*; E:* U. delphinus*; F:* U. gibbus*; G:* U. tumidiformis*; H:* U. ravoisieri*; I:* Anodonta anatina.

Figure 5. Siphons. A: Margaritifera auricularia*; B:* M. margaritifera*; C:* Potomida littoralis*; D:* Unio mancus*; E:* U. delphinus*; F:* U. gibbus*; G:* U. tumidiformis*; H:* U. ravoisieri*; I:* Anodonta anatina.

(Página derecha) Figura 6. Gloquidios. A: *Margaritifera auricularia*; B: *M. margaritifera*; C, D: *Potomida littoralis*; E, F: *Unio mancus.*

(Pagina direita) Figura 6. Gloquídios. A: Margaritifera auricularia*; B:* M. margaritifera*; C, D:* Potomida littoralis*; E, F:* Unio mancus.

(Right page) Figure 6. Glochidia. A: Margaritifera auricularia*; B:* M. margaritifera*; C, D:* Potomida littoralis*; E, F:* Unio mancus.


A
50 µm
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D
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E
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F
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se han obtenido resultados positivos con la gambusia (*Gambusia holbrooki* Girand) (LÓPEZ Y ALTABA, 2005).

En ninguna de las poblaciones conocidas existen ejemplares juveniles vivos.

Hábitat: Aparte de la excepción que suponen los canales Imperial y de Tauste, donde los ejemplares viven semienterrados en fondos naturales de arenas y gravas (Figs. 7A, B), es una especie propia de ríos grandes y caudalosos de aguas duras. Vive en los brazos laterales separados por islas, donde el agua se remansa y los peces paran para alimentarse o frezar. Cuando aparece en el cauce principal, suele ser en zonas donde la corriente es menor por la presencia de meandros. También habita en zonas de rápidos y aguas someras, donde vive muy clavada entre las piedras. Requiere fondos con sustratos de gravas asentadas y estables, no pudiendo sobrevivir durante mucho tiempo en barras de gravas movibles o fondos de cieno.

Como en todas las náyades, su hábitat es el de los correspondientes peces hospedadores, por lo que el conocimiento de la biología de éstos puede aportar las claves sobre el hábitat del molusco. Las colonias de náyades serán siempre más abundantes donde los peces hospedadores de sus gloquidios pasen más tiempo; por ello, las áreas de sombra de las orillas y los taludes, donde los peces bentónicos pasan gran parte de su vida, suelen ser especialmente favorables para las náyades.

Conservación: Amparada por las siguientes figuras de protección: En Peligro de extinción en el Catálogo Nacional de Especies Amenazadas y en el Catálogo de Especies Amenazadas de Aragón. Catálogo de Especies Amenazadas de Cataluña: Especie protegida de la fauna salvaje autóctona A. Libro Rojo de los Invertebrados de España: En Peligro crítico (VERDÚ Y GALANTE, 2006). IUCN: En Peligro crítico. Directiva Hábitats (Anexo IV): Especies animales y vegetales de interés comunitario que requieren una protección estricta. Convenio de Berna (Anexo II): Especies animales y sus hábitats estrictamente protegidos. En Aragón existe un Plan de Recuperación para la especie. Se ha redactado además un Plan de Acción de la Comunidad Europea (ARAUJO Y RAMOS, 2001).

Al ser su área de presencia tan reducida, sus poblaciones tan poco numerosas y aisladas unas de otras, y no existir en ninguna reclutamiento, el riesgo de extinción de la especie es gravísimo. La falta de efectivos en el Río Ebro y el declive o desaparición de las dos únicas especies hospedadoras de sus gloquidios, hace prácticamente imposible la reproducción natural. Además de todas las alteraciones que está sufriendo su hábitat, la invasión de especies de moluscos [mejillón cebra -*Dreissena polymorpha* (Pallas)- y almeja asiática -*Corbicula fluminea* (Muller)] y peces exóticos en aguas del Ebro puede ser letal para la especie.

La medida necesaria más urgente para conservar a *M. auricularia* es garantizar la supervivencia de la población del Canal Imperial de Aragón frente a las agresiones que está sufriendo ese ecosistema por los actuales planes de modernización (GÓMEZ Y ARAUJO, 2008), para lo que sería necesario incluir la especie en el Anexo II de la Directiva Hábitats y posteriormente protejer el Canal bajo una ley apropiada que asegure la conservación tanto del patrimonio natural (la especie y su hábitat) como del cultural y artístico (la obra civil).

Margaritifera margaritifera (Linnaeus, 1758)

Sinónimos:

Unio elongata Lamarck, 1819 (syn. fide Nilsson, 1822). *Hist. Nat. Anim. sans Vert.* Paris, vol. 6: 70.

Alasmodonta arcuata Barnes, 1823 (syn. fide Lea, 1834). *Amer. J. Sci.*, New Haven, 6: 277; lám. 12, fig. 20.

Unio roissyi Michaud, 1831. *Compl. Hist. nat. Moll. Draparnaud*: 112, lám. 16, figs. 27-28.

Unio brunnea Bonhomme, 1840 (syn. fide Dupuy, 1847). *Mém. Aveyron*, 2: 460.
Unio tristis Morelet, 1845 (syn. fide Haas, 1917a). *Moll. terr. fluv. Portugal*: 107, lám. 31, fig. 2.
Margaritana freytagi Kobelt, 1886 (syn. fide Haas, 1940). *Jb. nassau. Ver. Naturk.*, Wiesbaden, 39: 98, lám. 8, figs. 1-4.
Margaritana michaudi Locard, 1889 (syn. fide Germain, 1931). *Contr. faune malacol. franç.*, 13: 17.
Margaritana pyrenaica Bourguignat in Locard, 1889. (syn. fide Germain, 1931). *Contr. faune malacol. franç.*, 13: 150.
Margaritana alleni Castro in Locard, 1899 (syn. fide Haas, 1917a). *Arch. Mus. Hist. nat. Lyon*, 7: 212.
Margaritana durrovensis Philips, 1928. *Proc. malac. Soc. London*, 18: 69-74, lám. 3-4.

Descripción original: *Mya margaritifera* Linnaeus, 1758. *Systema Naturae*, ed. 10, 1: 671.
Localidad tipo: En los torrentes de todo el orbe septentrional (*In totius orbis arctici cataractis*).
Ilustrado en: Lister, 1685. *Appendicis ad Historiam Animalium Angliae, London*, lám. I, fig. 1. Pontoppidan, 1755. *The Natural History of Norway* etc, pág. 165; Lister, 1770. *Historiae sive sinopsis methodicae Conchyliorum et, Oxford*, fig. 149; Schröter, 1779. *Die Geschichte der Flüssconchylien, etc. Halle*, lám. 4, fig. 1.

Comentario taxonómico: Esta especie fue ilustrada por LISTER (1685) y PONTOPPIDAN (1755) antes incluso de ser descrita por Linneo. La población de aguas calizas de Irlanda descrita como *M. durrovensis* Phillips, 1928 se considera actualmente como un ecotipo de la especie (MACHORDOM *ET AL.*, 2003; LUCEY, 2006).

Distribución: Holártico. Históricamente la especie se distribuía por todos los ríos salmoneros y trucheros de la costa occidental europea entre los 40 y 60º N, desde la península Ibérica hasta la costa Ártica de la antigua URSS (península de Kola), y la costa este de América del Norte (ZIUGANOV, ZOTIN, NEZLIN Y TRETIAKOV, 1994).

En la península Ibérica (Fig. 8) se conocen poblaciones en ríos atlánticos desde el Baixo Miño hasta el Narcea (ÁLVAREZ-CLAUDIO *ET AL.*, 2000; San MIGUEL *ET AL.*, 2004), en siete afluentes del Duero: Águeda (Salamanca), Tera y Negro (Zamora), Paiva, Tuela, Mente y Rabaçal (Portugal), en los ríos Cávado y Neiva (Portugal), en el curso alto del Bibey (cuenca del Miño) (Zamora) y en un afluente del Tajo, el río Alberche (Ávila) (VELASCO *ET AL.*, 2002, 2006; REIS, 2003; MORALES *ET AL.*, 2004; LIFE-NÁYADE, 2005; VELASCO Y ROMERO, 2006).

Morfología externa (Figs. 9, 10): Concha de color marrón oscuro a casi negro, gruesa, robusta y moderadamente comprimida. Los juveniles son de color ámbar brillante a rojizo (Fig. 9B). El margen dorsal ligeramente arqueado junto con el ventral generalmente cóncavo le confieren una forma arriñonada, aunque en zonas de gravas heterométricas y fuerte corriente se pueden encontrar ejemplares de siluetas irregulares o deformes. El umbo está desplazado hacia la parte anterior, no sobresale de la concha y en los adultos suele aparecer sin periostraco y muy erosionado. Externamente se distingue de *M. auricularia* por ser más ovalada, pequeña y frágil.

El interior de la concha es de color blanco nacarado con irisaciones de diversas tonalidades. Las impresiones de los músculos aductores son muy patentes, tanto la del anterior, reniforme, como la del posterior, ovalado. La impresión del músculo retractor pedal es más evidente que la del protractor, aunque su límite se desdibuja fusionándose con la del aductor anterior. La charnela es larga con dientes laterales vestigiales o prácticamente ausentes en los adultos, aunque sí existen en los juveniles. La valva izquierda tiene dos dientes cardinales poco desarrollados y uno la derecha; suelen ser comprimidos lateralmente, recurvados y levemente aserrados en su parte superior.

Presenta las mismas particularidades anatómicas de la especie anterior: papilas del sifón inhalante pequeñas y arborescentes (Fig. 5B), nunca cónicas, carece de abertura supra-anal, diafragma incompleto y septos interlamela-

res distribuidos al azar entre las dos láminas de cada branquia.

Ciclo de vida: Al igual que el resto de las especies de la familia Margaritiferidae, *M. margaritifera* incuba sus larvas en las cuatro branquias, pudiendo albergar una hembra adulta grávida de 3 a 10 millones de embriones (Ross, 1992). Los gloquidios (Fig. 6B) son muy pequeños (60 x 70 μm), y aunque se han descrito como carentes de dientes o espinas (Nezlin, Cunjak, Zotin y Ziuganov, 1994; Pekkarinen y Valovirta, 1996), Harms (1907, 1909) menciona la existencia de unos pequeños dientes en el borde ventral.

En el río Varzuga (Península de Kola, Rusia) la gametogénesis ocurre entre finales de agosto y mediados de septiembre, con una liberación de gloquidios de entre 6-8 semanas y presencia de peces infestados desde mediados de septiembre a finales de junio del año siguiente (Ziuganov *et al.*, 1994). En los ríos de Galicia sin embargo, parece que la gametogénesis se produce en primavera-verano y que la proporción de ejemplares hermafroditas simultáneos es elevada (Grande *et al.*, 2001). En ríos del noroeste de Zamora se ha visto que el periodo de gravidez se extiende entre mediados de agosto y mediados de octubre con gran simultaneidad en todos los individuos (LIFE-Náyade, 2006; Morales, datos no publicados).

Los gloquidios tienen una mortalidad superior al 99% en los primeros días (Jansen, Bauer y Zahner-Meike, 2001), por lo que disponen de poco tiempo para ponerse en contacto con las branquias del pez hospedador. El salmón del Atlántico (*Salmo salar* L.) y el reo (*Salmo trutta trutta* L.) parecen ser los hospedadores óptimos de *M. margaritifera*, mientras que otros salmónidos como la trucha arco-iris [*Oncorhynchus mykiss* (Walbaum)], o ciprínidos reófilos como foxinos, bogas o barbos son resistentes a las larvas (Bauer, 1987a, b, 1997, 2001; Bauer y Vogel, 1987; Ziuganov *et al.*, 1994; LIFE-Náyade, 2006). La ausencia de *Salmo salar* en la mayoría de los ríos de Europa occidental desde hace 5 ó 6 décadas es probablemente la razón por la cual sea actualmente la trucha el principal hospedador; por lo tanto, es imprescindible la presencia de efectivos de *S. trutta* var. *fario* L. en los ríos interiores ibéricos donde probablemente nunca han existido salmones.

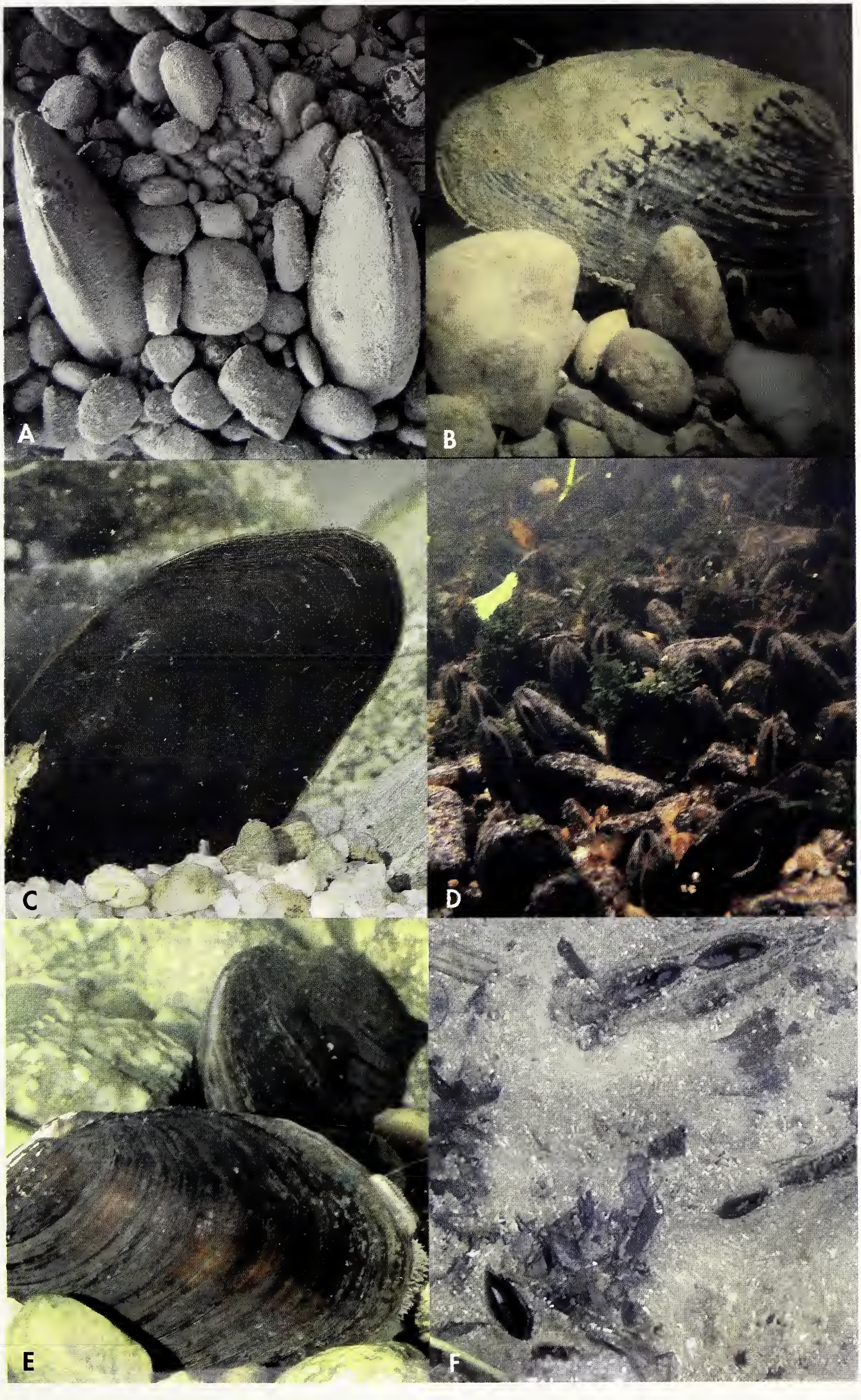
La expulsión de gloquidios se realiza de forma dependiente de la temperatura del agua (Hastie y Young, 2003), rodeados de una masa mucosa translúcida que permanece a la deriva en la columna de agua (Ondina obs. pers.). Dado que los alevines de peces se alimentan mayormente por deriva en zonas someras y de fuerte turbulencia, esta estrategia de las náyades podría incrementar su éxito reproductivo aumentando la probabilidad de que los gloquidios sean ingeridos por el hospedador. El tiempo de permanencia de los gloquidios en las branquias del pez es variable, entre 10 y 12 meses aproximadamente (Bauer, 1994; Hastie y Young, 2003). Los peces adultos parecen ser menos susceptibles a la infestación que los alevines de la última freza (edad 0+). Aunque esto se atribuye a fenómenos de inmunidad por infecciones previas (Bauer, 1987c; Ziuganov *et al.*, 1994), se ha observado tanto infestación como re-infestación de peces adultos (Young *et al.*, 1987; Geist *et al.*, 2006: LIFE-Náyade, 2006).

En condiciones favorables de experimentación, las náyades juveniles crecen de 0,5 a 2,5 mm en 26 meses de vida,

(Página derecha) Figura 7. Náyades vivas. A, B: *Margaritifera auricularia*; C, D: *M. margaritifera*; E, F: *Potomida littoralis*.

(Pagina direita) Figura 7. Náiades vivas. A, B: Margaritifera auricularia*; C, D:* M. margaritifera*; E, F:* Potomida littoralis.

(Right page) Figure 7. Living naiads. A, B: Margaritifera auricularia*; C, D:* M. margaritifera*; E, F:* Potomida littoralis.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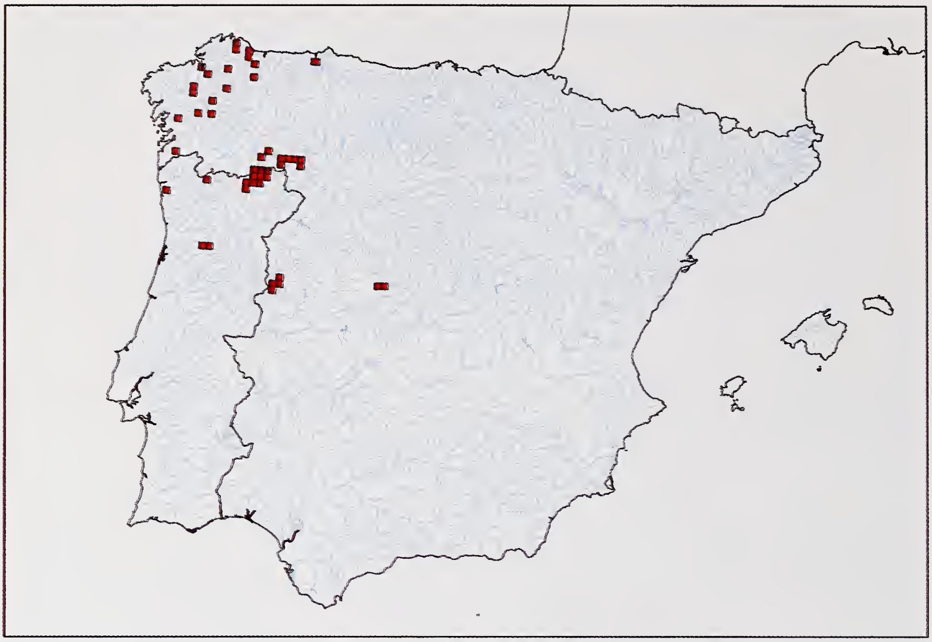


Figura 8. Distribución de *Margaritifera margaritifera.*
Figura 8. Distribuição de Margaritifera margaritifera.
Figure 8. Distribution map of Margaritifera margaritifera.

crecimiento que realiza *Unio pictorum* en menos de 11 meses (WÄCHTLER *ET AL.*, 2001).

La longevidad de *M. margaritifera* es excepcionalmente alta, aunque variable entre poblaciones dependiendo de la latitud y de las condiciones ambientales (BAUER, 1992; ZIUGANOV, SAN MIGUEL, NEVES, LONGA, FERNÁNDEZ, AMARO, BELETSKY, POPKOVITCH, KALUZHIN Y JOHNSON, 2000). En el río Keret (Karelia, Finlandia) alcanzan 167 años y un tamaño de 162 mm (ZIUGANOV *ET AL.*, 1994), mientras que en Bavaria (Alemania) la esperanza de vida está entre 30 y 132 años, con rangos de longitud máxima de 80-145 mm (BAUER, 1983, 1992). Tanto HENDELBERG (1961) como HASTIE, YOUNG, BONN, COSGROVE Y HENNINGER (2000a) señalan que es relativamente frecuente que la especie supere el siglo de vida en río subárticos de Suecia así como en poblaciones escocesas. Sin embargo, en Galicia, coincidiendo con el extremo meridional del rango de distribución de la especie, alcanza una longitud máxima aproximada de 95 mm, sobrepasando muy pocas veces los 130 mm, poseen una tasa de crecimiento superior a la de las poblaciones nórdicas con aguas más frías, especialmente los seis primeros años, y raramente alcanzan los 65 años de vida (SAN MIGUEL *ET AL.*, 2004). En los afluentes del Duero se han encontrado náyades de longitudes superiores a 130 mm (río Alberche), así como poblaciones muy dispares que ofrecen medianas poblacionales desde 64 (río Rabaçal) a 107 mm (río Tera) (REIS, 2003; LIFE-NÁYADE, 2004).

A diferencia del patrón de variación genética de las poblaciones centroeuropeas (GEIST Y KUEHN, 2005), las poblaciones gallegas poseen baja variabilidad intrapoblacional, alta diferenciación genética entre cuencas y unas tasas de autofecundación elevadas (entre un 48 y un 70%) (BOUZA *ET AL.*, 2007; TOLEDO, ARAUJO Y MACHORDOM, en rev.). Estos

Figura 9. *Margaritifera margaritifera.* A: río Landro (Lugo); B: juvenil del río Eo (Lugo).
Figura 9. Margaritifera margaritifera. *A: rio Landro (Lugo); B: juvenil do rio Eo (Lugo).*
Figure 9. Margaritifera margaritifera. *A: Landro river (Lugo); B: Juvenil from the Eo river (Lugo).*

resultados estarían en concordancia con la predicción genérica de las poblaciones periféricas: reducida variabilidad como resultado de un pequeño tamaño poblacional y aislamiento espacial. Todo ello puede considerarse estrechamente relacionado con la posibilidad de hermafroditismo simultáneo por parte de las hembras de las colonias sometidas a determinadas condiciones ambientales o de estrés poblacional por baja densidad de individuos (Bauer, 1987c).

Hábitat: En España únicamente habita en ríos salmoneros y trucheros de aguas limpias y muy poco calcificadas, frías, ácidas, transparentes y muy bien oxigenadas, con fondos de rocas, piedras y gravas, en ocasiones con sustratos finos y arenosos (Figs. 7C, D). Se conocen poblaciones desde casi a nivel del mar (río Eo) hasta zonas trucheras a más de 1000 m de altitud (río Bibey). Parece preferir profundidades entre 0,5 y 2 m, pero pueden vivir a mayor profundidad (Ziuganov *et al.*, 1994).

Suele formar colonias en las zonas más sombrías y cercanas a la orilla coincidiendo en los ríos peninsulares con aquellos tramos en los que se conserva el bosque de ribera original, dominado por *Alnus glutinosa* (Álvarez-Claudio *et al.*, 2000; Velasco *et al.*, 2002, 2006; LIFE-Náyade, 2004; Morales, Santos, Peñín y Palacios, 2007; Outeiro *et al.*, 2008). Estos agregados se distribuyen a lo largo del lecho fluvial, pudiéndose encontrar desde individuos aparentemente aislados a colonias de decenas de ejemplares.

Conservación: Catalogada en el Libro Rojo de los invertebrados de España como En Peligro (Verdú y Galante, 2006). Se ha incluido recientemente en la categoría En Peligro por la IUCN (2008), indicando que se encuentra enfrentada a un riesgo muy alto de extinción en estado silvestre en un futuro próximo. Existe un Plan de Acción de la Comunidad Europea (Araujo y Ramos, 2001) para la conservación de todas las poblaciones de sus Estados miembros. El declive de esta especie en Europa se considera dramático y está recientemente documentado en el 90% de su distribución conocida en el siglo XX (Young *et al.*, 2001).

A nivel autonómico únicamente ha sido incluida en el Catálogo Gallego de Especies Amenazadas, regulado por el Decreto 88/2007, en la categoría En Peligro de Extinción, lo que implica la elaboración de un Plan de Recuperación específico sobre el que actualmente se está trabajando. Castilla y León está desarrollando un Plan de Acción (LIFE-Náyade, 2005) emanado de los esfuerzos de estudio y gestión del hábitat realizados en Zamora a través del Programa LIFE-Náyade (LIFE03/NAT/E/000051).

Es importante reseñar que la elevada longevidad de esta especie, aún con importantes variaciones latitudinales, oculta su precario estado de conservación al poder persistir durante mucho tiempo poblaciones de adultos sin que exista reclutamiento. Así, aunque en los últimos diez años se ha ampliado de forma importante el conocimiento sobre el área de distribución de la especie en la Península, tanto en las colonias de baja como de alta densidad se observa un déficit importante de las cohortes más jóvenes (Álvarez-Claudio *et al.* 2000; Morales *et al.*, 2004; Morales *et al.*, 2007; Outeiro *et al.*, 2008). Esta ausencia de renovación generacional parece que data de las últimas décadas y que deriva de las profundas modificaciones que se han producido a lo largo del siglo XX en los cauces fluviales y en la calidad del agua. Todos los estudios coinciden en mostrar a *M. margaritifera* como una especie de requerimientos muy específicos y de tasa neta de crecimiento muy lento, lo que la hace especialmente vulnerable. Alteraciones físicas en los lechos (dragados, encauzamientos, obras públicas, centrales hidroeléctricas...) y en las cuencas hidrográficas (deforestación, repoblaciones intensivas con especies foráneas como eucaliptos y coníferas, incendios forestales, desertificación...) producen pérdida de microhábitat para los exigentes juveniles, ya que los intersticios oxigenados de los fondos de gravillas que precisan quedan aterrados (*-siltation-*) (Geist y

Figura 10. *Margaritifera margaritifera*. A: río Arnego (Pontevedra); B: río Tambre (La Coruña).
Figura 10. Margaritifera margaritifera. *A: rio Arnego (Pontevedra); B: rio Tambre (La Coruña).*
Figure 10. Margaritifera margaritifera. *A: Arnego river (Pontevedra); B: Tambre river (La Coruña).*

KUEHN, 2005; ZIUGANOV, KALUZHIN, BELETSKY, Y POPKOVITCH, 2001; MORALES *ET AL.*, 2007). La proliferación de residuos nitrogenados en los fondos producida por la contaminación química y orgánica, en especial amonio, produce un fuerte impacto que reduce las posibilidades de reclutamiento y las de reproducción para los hospedadores (AUGSPURGER, KELLER, BLACK, COPE Y DWYER, 2003; GEIST Y AUERSWALD, 2007). Si a la baja tasa de supervivencia de las fases larvarias y la elevada mortandad de los juveniles, se une la escasez de hospedadores propia de los ríos ibéricos, se puede comprender la vulnerabilidad de las poblaciones ante la falta de reclutamiento en ciclos muy prolongados.

Con excepción del hombre, la especie en estado adulto tiene pocos predadores naturales. Aunque en EEUU está documentado que puede ser presa de la rata cibelina [*Ondatra zibethicus* (L.)] (ZHANER Y HANSON, 2001) y en Escocia se han citado evidencias (COSGROVE, HASTIE Y SIME, 2007) de predación natural por parte de ostreros [*Haematopus ostralegus* (L.)], visón americano (*Mustela vison* Schreber) y nutria [*Lutra lutra* (L.)], en la península Ibérica no está descrita su predación por ningún vertebrado semiacuático. Sí se conocen, sin embargo, numerosos relatos de habitantes ribereños que aseguran haber sacrificado hace décadas grandes cantidades de ejemplares para alimentarse de ellos.

Dado que presentan unas características únicas respecto a las poblaciones europeas, y una situación más frágil por tratarse de poblaciones aisladas geográficamente en la periferia de su rango ecológico, es necesario un esfuerzo coordinado para la conservación de las poblaciones ibéricas. Cabe destacar la población del río Eo, con densidades puntuales de 53 náyades m^{-2} y un tramo con un 30% de ejemplares menores de 65 mm, es decir, de individuos menores de 10 años (OUTEIRO *ET AL.*, 2008), así como la del Rabaçal, con densidades de 50 náyades m^{-2} y buen reclutamiento (REIS, 2003). Aunque son datos relativamente bajos en comparación con los del norte de Europa (HASTIE *ET AL.*, 2000b), destacan frente a otros ríos de la península donde no se han detectado juveniles y raramente la densidad de adultos es superior a 1 náyade m^{-2} (VELASCO *ET AL.* 2002; REIS, 2003; MORALES *ET AL.* 2004, 2007; LIFE-NÁYADE, 2004). En otros ríos salmoneros se han encontrado algunos juveniles, como el Narcea (ÁLVAREZ-CLAUDIO *ET AL.*, 2000) o el Masma (OUTEIRO *ET AL.*, 2008), aunque no en número suficiente como para asegurar la viabilidad de la población. En el río Alberche se localizaron algunos ejemplares de menos de 30 mm (VELASCO *ET AL.*, 2006).

Es de la máxima urgencia su inclusión en el nuevo Catálogo Español de Especies Amenazadas en la categoría En Peligro, y simultáneamente, la puesta en marcha de un amplio programa de restauración de sus hábitats y de regeneración de las poblaciones de truchas.

Potomida littoralis (Cuvier, 1798)

Sinónimos: Al igual que ocurre con la mayoría de las náyades, *P. littoralis* tiene una enorme variabilidad morfológica, lo que se refleja en los 31 sinónimos que aporta HAAS (1969) o en los 93 de GRAF (2007). En el listado siguiente solamente se han considerado nombres adjudicados a especies ibéricas y francesas.

Unio littoralis Lamarck, 1801. *Syst. Anim. sans Vert.*, 114.

Unio brevialis Lamarck, 1819. *Hist. Nat. Anim. sans Vert.*, 6: 73.

Unio subtetragonus Michaud, 1831. *Complément Hist. Nat. Moll. terr. fluv. France, Draparnaud*, 111, lám. XVI, fig 23.

Unio draparnaldii Deshayes, 1831. *Descr. Coqu. Terr.*, 38, lám. 14, fig. 6.

Unio incurvus Lea, 1831? *Trans. amer. philos. Soc., Philadelphia*, 4: 97, lám. 13, fig. 27.

Unio pianensis Farines in Boubée, 1833. *Bull. Hist. Nat. France*, 1, *Moll. Zoophyt.*, 27.

Unio cuneatus Jacquemin, 1835. *Guide Ror. Arles*, 124.

Unio rotundatus Mauduyt, 1839. *Tableau Indic. Moll. Vienne*, 9, lám. 1, fig. 314.
Unio barraudi Bonhomme, 1840. *Mèm. Soc. Aveyron*, 2: 430.
Unio bigerrensis Millet, 1843. *Mag. Zool.*, 3, lám. 64, fig. 2.
Unio littoralis var. *umbonatus* Rossmässler, 1844. *Iconog. Land Süsw. Moll.*, 4: 36, lám. 69, fig. 849.
Unio astierianus Dupuy, 1850. *Hist. Moll. France*, 636, lám. 23, fig. 9.
Unio moulinsianus Dupuy, 1850. *Hist. Moll. France*, 640, lám. 24, fig. 10.
Unio rhomboideus Moquin-Tandon, 1855. *Hist. Moll. terr. fluv. France*, 2: 508, lám. 47, figs. 4 a 9.
Unio subreniformis Bourguignat, 1863. *Moll. nouv. lit. peu connus*, 138, lám. 34, figs. 4 a 6.
Unio hippopotami Bourguignat, 1869. *Cat. Moll. terr. fluv. Paris quaternaire*, 21, lám. 3, figs. 52 a 54.
Unio bigorriensis Locard, 1882. *Prodr. Malac. franç.*, 1: 284.
Unio rathymus Bourguignat in Locard, 1882. *Prodr. Malac. franç.*, 1: 284.
Unio hispalensis Kobelt, 1887. *Iconog. Land Süsw. Moll.*, (2) 3: 53, lám. 88, fig. 492.
Unio calderoni Kobelt, 1887. *Iconog. Land Süsw. Moll.*, (2) 3: 54, lám. 88, fig. 494.
Unio gandiensis Drouet, 1888. *J. de Conch. Paris*, 28: 103.
Unio pacomei Bourguignat in Locard, 1889. *Contrib. faune malac. franç.*, 13: 20.
Unio calderoni var. *salvadori* Kobelt, 1892. *Nachr. Bl. dtsch. malak. Ges., Frankfurt a. M.*, 24: 201.
Unio circulus Bourguignat in Locard, 1893. *Coq. Eaux douces saum. France*, 153.
Unio sphaericus Bourguignat in Locard, 1893. *Coq. Eaux douces saum. France*, 153.
Unio circinatus Drouet, 1893. *Unionidae de l'Espagne*, 33, fig. 6.
Unio rhysopigus Drouet, 1893. *Unionidae de l'Espagne*, 37, fig. 7.
Unio mauduyti Germain, 1897. *Bull. Soc. Sci. nat. Rouen*, 70. *Nomen novum* por *Unio rotundatus* Mauduyt, 1839, no *Unio rotundatus* Lamarck, 1819.
Unio littoralis taginus Kobelt, 1903. *Iconog. Land Süsw. Moll.*, (2) 10: 28, lám. 279, fig. 1795.
Unio kinkelini Haas, 1908. *Nachr. Bl. dtsch. malak. Ges., Frankfurt a. M.*, 40: 177.
Unio batavus catalonicus Haas in Bofill y Haas, 1920. *Treb. Mus. Cienc. nat. Barcelona*, 3 (3): 291, 363, lám. 3, figs. 19 a 22.

Descripción original: *Unio littoralis* Cuvier, 1798. *Tableau élèmentaire de l'histoire naturelle des animaux*, p. 425.
Ilustrado en: Bruguière, 1797. *Tableau encyclopédique et méthodique des trois regnes de la nature, Paris*, lám. 248, fig. 2; Araujo, 2008. *Graellsia*, 64 (1): fig. 1. Ambas figuras ilustran probablemente el ejemplar tipo.

Comentario taxonómico: De los 7 taxa que HAAS (1969) considera dentro del grupo *Potomida littoralis*, solamente dos se distribuyen por la península Ibérica, *P. l. littoralis* (Cuvier) [no Lamarck, como dice HAAS (1969)] y *P. l. umbonata* (Rossmässler), pero los dos pertenecen a la misma especie *P. littoralis* (REIS ET AL. en rev.), a su vez la misma que se distribuye por Francia (datos sin publicar). Las cinco especies de *Potomida* que cita ALTABA (1991) en los ríos del mediterráneo "catalán" corresponden a *P. littoralis*.

Esta especie ha sido adscrita a los géneros *Potomida*, Swainson (1840), *Psilunio*, Stefanescu (1896) y *Rhombunio*, Germain, 1991. También ha sido citada con autor equivocado como *Unio littoralis* (Lamarck, 1801) y como *Unio rhomboideus* (Schröter, 1779). Recientemente se ha intentado aclarar toda esta confusión nomenclatorial (ARAUJO, 2008).

Distribución: Paleártica circunmediterránea. Suroeste de Europa: Francia, España, Portugal y Grecia (HAAS, 1969; ARAUJO, 2008). También en el norte de África (Marruecos, Argelia y Túnez) y suroeste de Asia (Armenia, Turquía, Siria, Israel y Palestina), aunque probablemente se trate de especies diferentes de aspecto muy similar a *P. littoralis* (datos sin publicar). Fósil en el Pleistoceno de las Islas Británicas, Alemania, Balcanes y sur de Rusia (ELLIS, 1978).

En la península Ibérica (Fig. 11) tiene un área de distribución muy amplia, ocupando la mayoría de las vertientes atlánticas y mediterráneas.

Morfología externa (Fig. 12): Aunque de aspecto muy variable dependiendo del hábitat, quizá sea la especie de náyade ibérica más fácil de identificar. Concha sólida, alta y gruesa, de contorno variable: oval, elíptica, romboide o

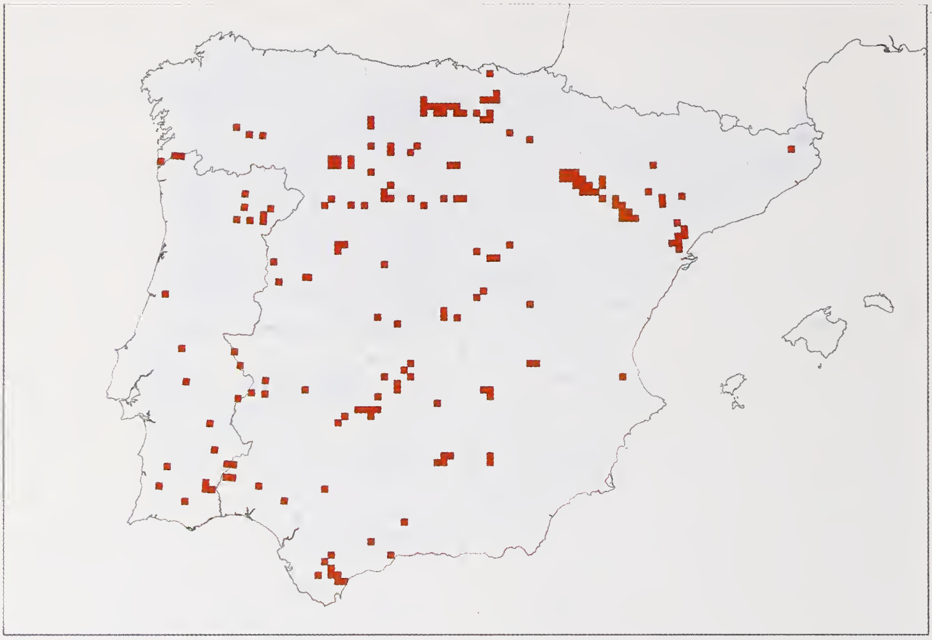


Figura 11. Distribución de *Potomida littoralis*.
Figura 11. Distribuição de Potomida littoralis.
Figure 11. Distribution map of Potomida littoralis.

ligeramente cuadrangular. Color oscuro, de castaño a negro, a veces verdoso y en ocasiones con líneas amarillentas radiales que parten del umbo. Los juveniles de 1-2 cm tienen un color pardo claro y la escultura del umbo se caracteriza por abundantes pliegues ondulados bien marcados (Fig. 13A) . En los adultos el periostraco suele estar desgastado, dejando visible zonas calcáreas blancas. Charnela corta y fuerte, con dientes cardinales piramidales cónico obtusos, fuertes y aserrados: valva izquierda con 2 dientes laterales y 2 cardinales y valva derecha con 1 diente lateral y 1 cardinal. Inserción del músculo aductor anterior muy marcada. Normalmente alcanzan tamaños de 6-8 cm, habiéndose señalado como dimensiones máximas: 9,2 cm de longitud, 6,4 cm de altura y 3,1 cm de anchura (Haas, 1941).

Como en todas las especies de la familia Unionidae, presentan una abertura supra-anal dorsal a los sifones inhalante y exhalante. En la abertura inhalante (Fig. 5C) se observan papilas cónicas de diferentes tamaños (más pequeñas en el margen exterior) y en la abertura exhalante, como en otros uniónidos, el borde parece ligeramente aserrado por la presencia de papilas incipientes que no llegan a asomar.

Los septos de los filamentos branquiales están perforados y no son continuos como en otros uniónidos, aunque en otras especies se ha observado que esta característica puede variar con la época de reproducción, de forma que durante la incubación, los septos aparecen abiertos (Nagel *et al.*, 1998).

Ciclo vital: Como la mayoría de los Unionoidea es una especie dioica. Alcanzan la madurez sexual a los 4-5 años de edad, cuando miden aproximadamente 4 cm (Nagel, 2004). A diferencia de otras especies de la familia, las 4 branquias (y no solamente las 2 exteriores) actúan como marsupio para la incubación (Haas, 1917b). En el Ebro se han visto hembras grávidas en julio y agosto

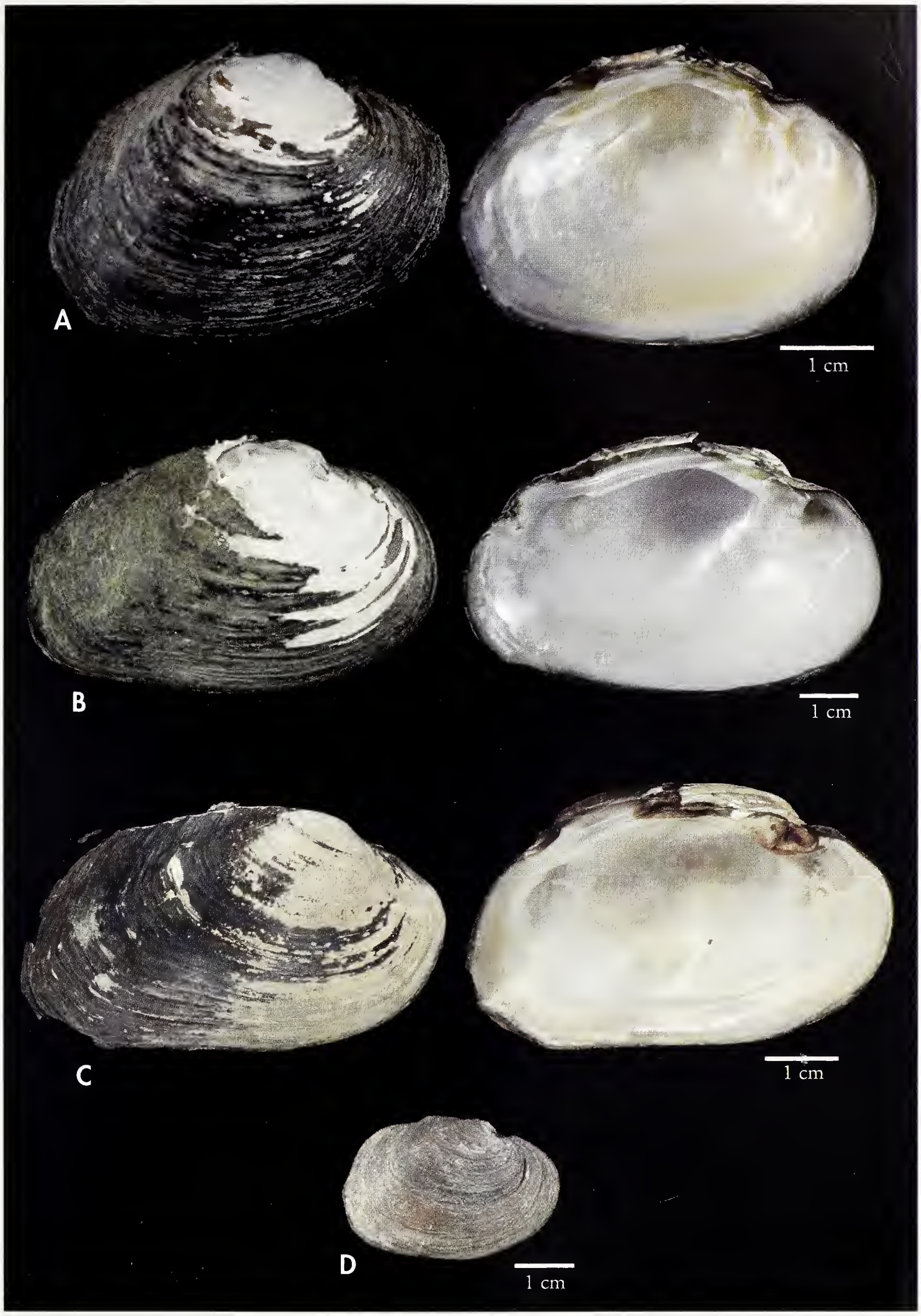


Figura 12. *Potomida littoralis*. A: río Vascao (Beja/Faro); B: río Valdeazogues (Ciudad Real); C, D: río Ebro.

Figura 12. Potomida littoralis. *A: rio Vascão (Beja/Faro); B: rio Valdeazogues (Ciudad Real); C, D: rio Ebro.*

Figure 12. Potomida littoralis. *A: Vascao river (Beja/Faro); B: Valdeazogues river (Ciudad Real); C, D: Ebro river.*

y juveniles recién nacidos a principios de septiembre (HAAS, 1917b), así como gloquidios entre los meses de marzo a octubre (ARAUJO *ET AL.*, 2000). Probablemente su época de reproducción no está sincronizada, de forma que no todos los adultos de una población se reproducen a la vez (NAGEL, 2004). Los gloquidios (Figs. 6C, D) miden 0,21 mm, tienen forma de cuchara y están dotados de minúsculas espinas cuticulares en el borde de las valvas, pero sin el fuerte gancho ventral típico de otros uniónidos (GIUSTI, 1973 ; NAGEL, 1999).

En la península Ibérica los peces hospedadores de sus gloquidios parecen ser los barbos (género *Barbus*), aunque también podrían actuar como tales las bogas (género *Chondrostoma*) (HAAS, 1917b; ARAUJO *ET AL.*, 2000).

Hábitat: Se trata de una especie típicamente fluvial, propia de los sectores medios y bajos de las cuencas. Aunque prefiere los ríos de mayor tamaño y caudal, vive también en afluentes menores con cierta corriente, en acequias y canales de riego que mantienen los fondos naturales, e incluso en grandes lagos (ej. Ruidera, Bañolas). En los canales del Ebro es la especie de náyade más común. Muchas veces se encuentra enterrada en zonas de sustratos gruesos, entre piedras y rocas, aunque también aparece en lugares tranquilos entre arena y fango (Figs. 7E, F). Puede vivir en la zona central del lecho del río, incluso hasta 6-10 m de profundidad (HAAS, 1917b; REIS, 2006), pero es más común entre las raíces de los árboles de las riberas y en los taludes. También entre piedras en zonas de rápidos y aguas someras. Habita en aguas de distinta naturaleza (silíceas, calizas) y, aunque necesita aguas limpias, no aparece en aguas oligotróficas de montaña.

Al igual que ocurre con sus distribuciones, existe una clara coincidencia entre los hábitats fluviales de esta especie y los de los peces bentónicos del género *Barbus*.

Conservación: Catalogada como Vulnerable en el Libro Rojo de los Invertebrados de España (VERDÚ Y GALANTE, 2006), De Interés Especial en el Catálogo de Especies Amenazadas de Castilla-La Mancha y Vulnerable en el Catálogo Gallego de Especies Amenazadas y en el Libro Rojo de los Invertebrados de Andalucía (BAREA-AZCÓN, BALLESTEROS-DUPERÓN Y MORENO, 2008).

Cada vez es menos frecuente encontrar grandes colonias, apareciendo poblaciones con muy pocos individuos y sin juveniles. Es una especie en franca regresión que ha desaparecido de muchas localidades en Galicia (ROLÁN, 1998), Comunidad Valenciana (MARTÍNEZ-ORTÍ Y ROBLES, 2003), Portugal (REIS, 2006), Madrid (SOLER, MORENO, ARAUJO Y RAMOS, 2006), Castilla y León (VELASCO Y ROMERO, 2006) y Andalucía (BAREA *ET AL.*, 2008).

Dado que la tasa actual de desaparición de las náyades es catastrófica, y que cada vez son mayores las afecciones sobre los ríos donde habita (tanto naturales -sequías, riadas- como artificiales -detracciones de agua, embalses, eutrofización-), se recomienda su inclusión en el nuevo Catálogo Español de Especies Amenazadas en la Categoría de Vulnerable.

Unio mancus Lamarck, 1819

Sinónimos: Se han listado como sinónimos de *U. mancus* todos los que HAAS (1969) considera sinónimos de *U. elongatulus mancus* Lamarck (ver más abajo) y *U. elongatulus moquinianus* Dupuy, pero no los de *U. e. requienii* Michaud. El listado de sinónimos de *U. mancus* no será definitivo hasta que se conozca la identidad exacta de las diferentes poblaciones europeas de las subespecies de *U. elongatulus*.

Unio moquinianus Dupuy, 1843. *Essai Moll. terr. fluv.*, 80, figs. 1-2.

Unio ardusianus Reyniès, 1843. *Lettre à Moquin-Tandon*, 5, lám. 1, figs. 7-8.

Unio aleroni Companyo y Massot, 1845. *Bull. Soc. Agricult. Sci. Lettr. Pyrén.-Orient., Perpignan*: 6, 234-235, fig. 2. (Sinonimizado por Bourguignat, 1866).

Unio valentinus Rossmässler, 1854. *Iconogr. Land-Sussw. Moll.*, 37, lám. 69, fig. 852.
Unio graellsianus Bourguignat, 1865. *Moll. nouv. litig. peu connus*, 147, lám. 23, figs. 4-7.
Unio courquinianus Bourguignat, 1865. *Moll. nouv. litig. peu connus*, 149, lám. 26.
Unio condatinus Letourneux in Locard, 1882. *Prodr. Malacol. franç.*, 1, 356.
Unio gobionum Bourguignat in Locard, 1882. *Prodr. Malacol. franç.*, 1, 364.
Unio mucidulus Bourguignat in Locard, 1882. *Prodr. Malacol. franç.*, 1, 366.
Unio mongazonae Servain, 1887. *Bull. Soc. malac. France, Paris*, 4, 253.
Unio asticus Servain, 1887. *Bull. Soc. malac. France, Paris*, 4, 259.
Unio eutrapelus Servain, 1887. *Bull. Soc. malac. France, Paris*, 4, 260.
Unio antimoquinianus Locard, 1889. Rév. Esp. franç. *Margaritana et Unio*, 121.
Unio oberthurianus Bourguignat in Locard, 1889. Rév. Esp. franç. *Margaritana et Unio*, 142.
Unio arcuatulus Bourguignat in Locard, 1889. Rév. Esp. franç. *Margaritana et Unio*, 138.
Unio amblyus Castro in Locard, 1889. Rév. Esp. franç. *Margaritana et Unio*, 119.
Unio almenarensis Drouet, 1893. *Mém. Acad. Sci. Arts Bell. Lettr., Dijon* (4): 4, 62, lám. 1, fig. 2.
Unio consentaneus var. *moquini* Germain, 1931. *Faune de France*: 22, 73, fig. 829.

Descripción original: *Unio mancus* Lamarck, 1819. *Histoire Naturelle des Animaux sans vertèbres*, 6 Parte 1: 80.
Localidad tipo: Río Drée en Borgoña, Francia.
Ilustrado en: Dupuy, 1843. *Essai sur les Mollusques terrestres et fluviatiles du département du Gers*, 80, figs. 1-2; Companyó y Massot, 1845. [*Bulletin de la*] *Société Agricole, Scientifique et Littéraire des Pyrénées-Orientales, Perpignan*: 6, 234-235, fig. 2; Rossmässler, 1854. *Iconographie der Land und Süsswasser Mollusken, etc.*, 37, lám. 69, fig. 852.

Comentario taxonómico: De las 17 subespecies de la especie mediterránea *Unio elongatulus* C. Pfeiffer, 1825 consideradas por Haas (1940, 1969), solamente dos se han citado en la península Ibérica: *U. elongatulus penchinatianus* Bourguignat, 1865, que viviría en los ríos del noreste mediterráneo hasta el Ebro, y *U. elongatulus valentinus* Rossmässler, 1854, en los ríos al sur del Ebro. Una tercera subespecie, *U. elongatulus mancus* Lamarck, 1819, cuya localidad tipo es el río Drée, sólo se distribuiría por Francia (Haas, 1969). Recientes estudios (Araujo *et al.*, 2005; Toledo *et al.*, datos no publicados) han demostrado que las poblaciones del Ebro y otros ríos mediterráneos ibéricos más al norte, salvo alguna excepción (ver comentario taxonómico de *U. ravoisieri*), y las de *U. e. valentinus*, pertenecen a la misma especie, que a su vez es la misma que vive en el río Drée. Es por eso que la especie ibérica debe llamarse *U. mancus* Lamarck, 1819.

Es interesante comentar aquí que una cuarta subespecie, *U. elongatulus aleroni* Companyó y Massot, según Haas (1969) exclusiva del sur Francia, es también un sinónimo de *U. mancus*, lo que se ha comprobado (Toledo *et al.*, datos no publicados) analizando dos genes mitocondriales de ejemplares del río Basse (Sur de Francia), localidad tipo de *U. aleroni*. La historia de la descripción de *U. aleroni* es muy curiosa, ya que sus autores renegaron de la especie una vez leídos los comentarios de Bourguignat (1866) sobre las deficiencias que este autor achacó a su descripción (ver Azpeitia, 1933 págs. 263-264). Bourguignat fue así el primero en advertir que la especie de Companyó y Massot era la misma que el *U. mancus* del levante ibérico (el cual cita como *U. requieni*), mientras que prácticamente al mismo tiempo describía la especie *U. penchinatianus* del lago de Bañolas (Bourguignat, 1865), especie que en Cataluña ha sido confundida con *U. aleroni*, y que a su vez es un sinónimo del taxón norteafricano *U. ravoisieri* Deshayes, 1847 (ver comentario taxonómico de esta especie).

Altaba (1991) cita la presencia de cuatro táxones diferentes de *U. elongatulus* en los ríos del levante "catalán", incluyendo *U. e. aleroni*. Salvo en el caso del lago de Bañolas y del río Ser, en los que se trata de *U. ravoisieri*, todas estas citas pertenecen probablemente a *U. mancus*.

Distribución: En la península Ibérica (Fig. 14) vive en los ríos de las cuencas mediterráneas con un límite meridional situado en la cuenca del Júcar. Hasta que no se haga un estudio detallado de todas las subespecies de *U. elongatulus* consideradas por HAAS (1969), se desconoce su distribución europea.

Es la única especie de *Unio* de la cuenca del Ebro, donde vive con *Potomida littoralis*, *Anodonta anatina* y *Margaritifera auricularia*, y la más común en los ríos del mediterráneo ibérico. También se ha encontrado junto con *U. ravoisieri* en el lago de Bañolas.

Morfología externa (Fig. 15): junto con *U. delphinus* es la especie ibérica de *Unio* más variable, ya que también presenta caracteres externos diferentes según el hábitat. Solamente por la concha es muy difícil de distinguir de *Unio elongatulus*, e incluso puede ser confundida con la especie atlántica ibérica *U. delphinus*. Por su distribución, solamente puede confundirse con ejemplares simpátricos de *U. ravoisieri*, pues los individuos de esta especie que viven en ríos pueden ser muy similares a los de *U. mancus*.

Forma muy variable, con ejemplares de concha pequeña, muy fina y delicada, hasta otros con concha muy robusta. Presenta el aspecto típico de mejillón o almeja de río con una concha generalmente abombada y alargada de coloración pardo-negruzca o pardo-amarillenta con zonas más verdosas. Concha inequilateral con la parte anterior redondeada y la posterior alargada y truncada, acabando en un corto pico. Umbo prominente, redondeado y prosogirado que en ocasiones puede presentar escultura umbonal, simple u ondulada, consistente en 2 filas de tubérculos, una medial y otra posterior. El interior de las valvas es blanco nacarado brillante y presenta una línea paleal muy marcada entre las cicatrices de los músculos aductores anterior y posterior. El ligamento que articula las dos valvas es externo y discurre por el borde dorsal. Valva izquierda con dos dientes posteriores de aspecto laminar y muy alargados y dos dientes cardinales crenulados, muy pronunciados en los ejemplares más alargados, que en ocasiones pueden aparecer fusionados en una única estructura laminar. La valva derecha presenta un diente lateral posterior muy alargado y un único diente cardinal que puede resultar muy variable incluso entre los ejemplares de una misma población, donde se pueden observar desde estructuras robustas y crenuladas a formas más delicadas y de aspecto laminar. El tamaño siempre es menor de 10 cm y raramente supera los 9 cm.

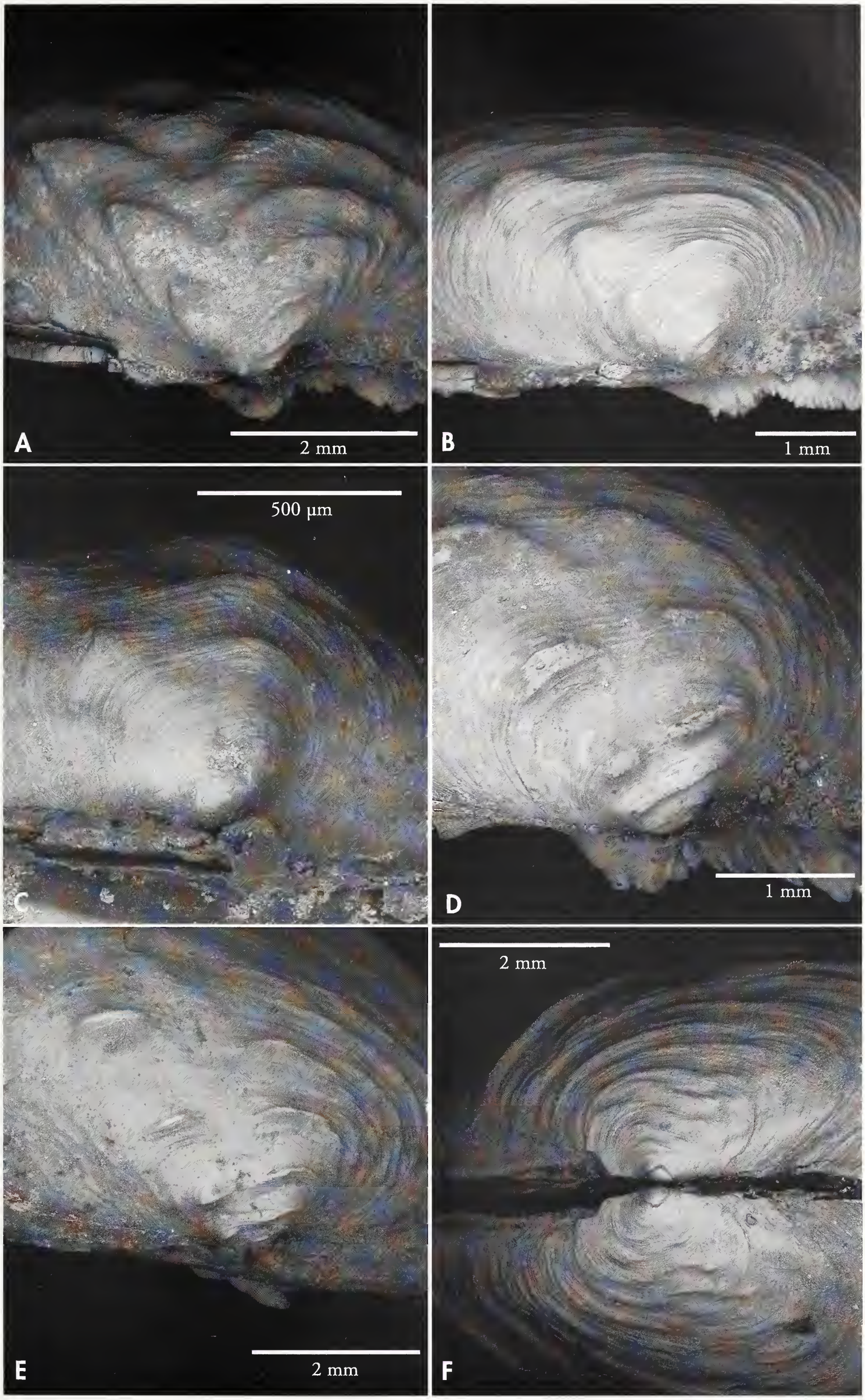
Sifón inhalante con papilas cónicas típicas, a veces ramificadas (Figs. 5D, 16B).

Ciclo vital: En la cuenca del Ebro HAAS (1917) encontró ejemplares grávidos entre los meses de julio y agosto, mientras que ARAUJO *ET AL.* (2000) observaron la liberación de gloquidios entre los meses de marzo y octubre. En experimentos realizados en acuarios la emisión de gloquidios se produjo desde final de abril hasta agosto. La cámara de las branquias externas es la única que actúa como marsupio para la incubación de los gloquidios. Éstos son blanquecinos y triangulares y presentan un fuerte gancho en el centro del borde ventral, que aparece armado con numerosas espículas (Figs. 6E, F). El tamaño medio (medidos al microscopio electrónico) es de 216,8 μm de longitud (ds=7,58; n=15), 193,3 μm de altura (ds=13,31; n=13) y 162 μm de anchura (ds=1,99; n=2) (ARAUJO *ET AL.*, 2005).

(Página derecha) Figura 13. Esculturas umbonales. A: *Potomida littoralis*; B: *U. delphinus*; C: *U. gibbus*; D: *U. tumidiformis*; E: *U. ravoisieri*; F: *Anodonta anatina*.

(Pagina direita) Figura 13. Escultura do umbo. A: Potomida littoralis*; B:* U. delphinus*; C:* U. gibbus*; D:* U. tumidiformis*; E:* U. ravoisieri; *F:* Anodonta anatina.

(Right page) Figure 13. Umbonal sculptures. A: Potomida littoralis*; B:* U. delphinus*; C:* U. gibbus*; D:* U. tumidiformis*; E:* U. ravoisieri*; F:* Anodonta anatina.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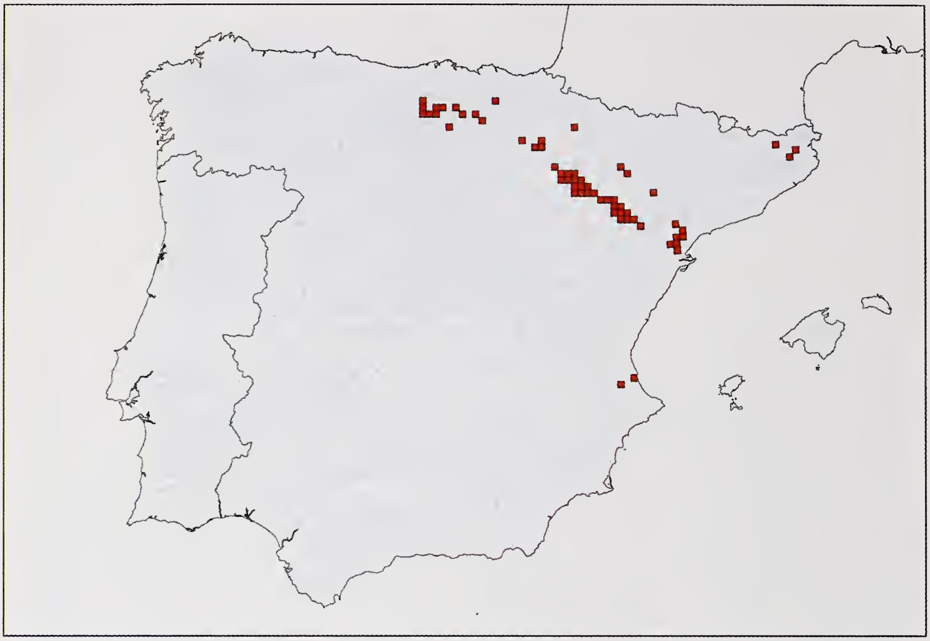

Figura 14. Distribución de *Unio mancus*.
Figura 14. Distribuição de Unio mancus.
Figure 14. Distribution map of Unio mancus.

Experimentos realizados en laboratorio (ARAUJO *ET AL.*, 2005) han permitido identificar hasta siete especies diferentes de peces en los que los gloquidios de *U. mancus* completan su metamorfosis y que podrían por lo tanto actuar como hospedadores de esta especie: *Barbus graellsii* Steindachner, *Barbus haasi* Mertens, *Squalius pyrenaicus* (Günther), *Squalius cephalus* (L.), *Chondrostoma miegii* Steindachner, *Phoxinus phoxinus* L. *y Salaria fluviatilis* (Asso). Se han obtenido ejemplares juveniles en 141 grados/día. Las pruebas realizadas con *Cyprinus carpio* L., *Gobio gobio* (L.) y *Acipenser baerii* Brandt dieron buenos resultados en la infestación, pero los gloquidios se desprendieron antes de completar su metamorfosis. En condiciones naturales, tan sólo se han obtenido resultados positivos de infestación con *Barbus graellsii* entre un total de siete especies pescadas (ARAUJO *ET AL.*, 2005). Los gloquidios se fijan a las branquias (90%) y aletas (10%).

Hábitat (Fig. 16A): Se trata de una especie típicamente fluvial que, a excepción de las zonas de alta montaña, es capaz de ocupar todo tipo de tramos de ríos, tanto de primer orden como de afluentes menores, así como canales de riego que mantengan sus fondos naturales. Aunque no es muy común, puede aparecer también en grandes embalses (MADEIRA, ARAUJO Y AYALA, 2007), así como en lagos (ej. Albufera de Valencia, Bañolas). Vive generalmente semienterrado en fondos de gravas bien asentadas de los brazos secundarios del río, en el centro del cauce en zonas con poca corriente y en los taludes bien conservados a la sombra de la vegetación de ribera e incluso entre las raíces de los árboles. Todos ellos hábitats fluviales donde los peces hospedadores de sus gloquidios pasan gran parte de su vida. Sin embargo, también se han localizado ejemplares en zonas de sustrato grueso encajados entre piedras y rocas, en fondos de fango y materia orgánica y en

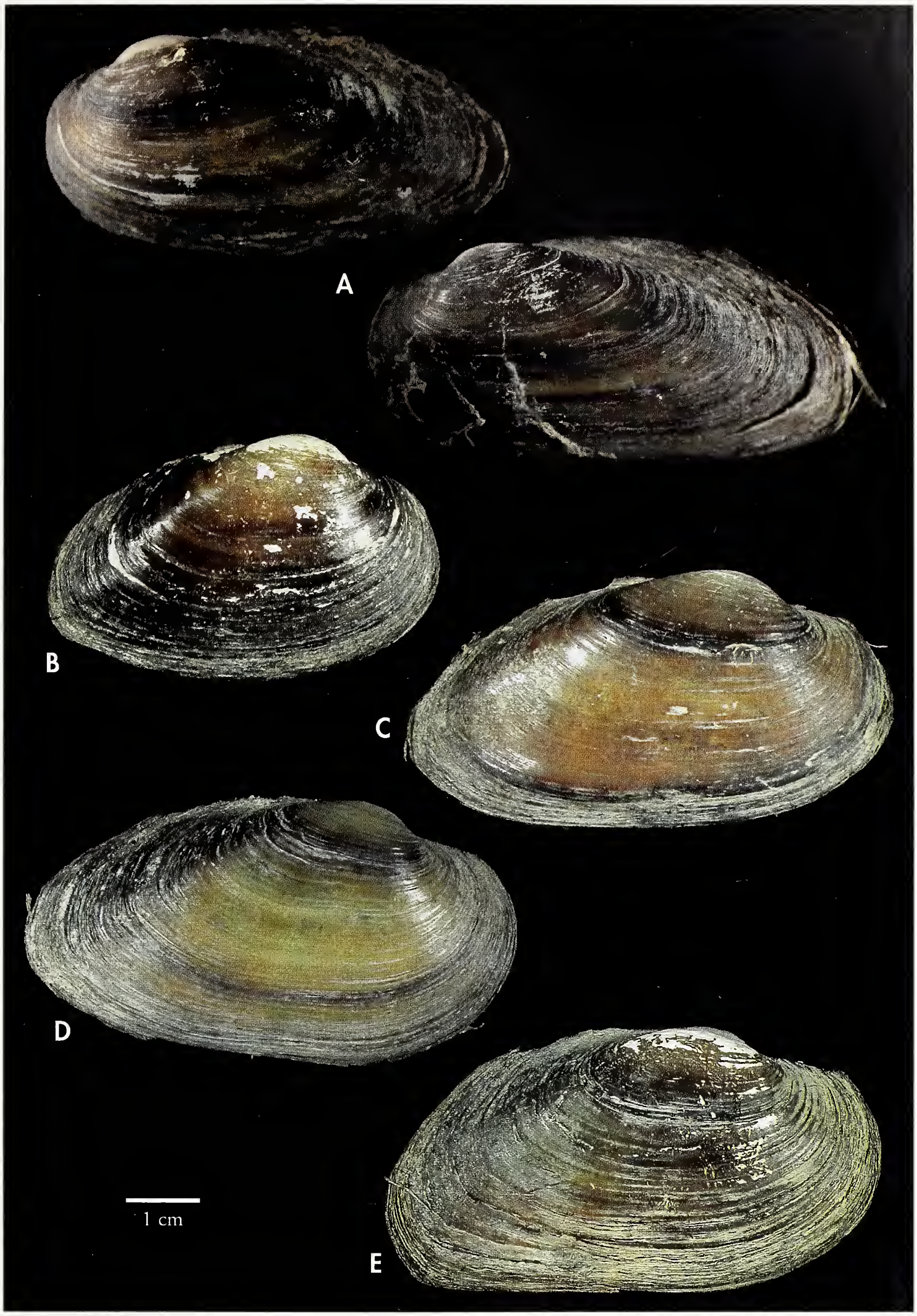

Figura 15. *Unio mancus.* A: río Brugent (Gerona); B: Canal Imperial de Aragón (Zaragoza); C: río Ebro en Sástago (Zaragoza); D: acequia El Barranquet (Valencia); E: río Irati (Navarra).
Figura 15. Unio mancus. A: rio Brugent (Gerona); B: Canal Imperial de Aragón (Zaragoza); C: rio Ebro em Sástago (Zaragoza); D: vala El Barranquet (Valencia); E: rio Irati (Navarra).
Figure 15. Unio mancus. A: Brugent river (Gerona); B: Canal Imperial de Aragón (Zaragoza); C: Ebro river at Sástago (Zaragoza); D: El Barranquet ditch (Valencia); E: Irati river (Navarra).

playas de arena. Teniendo en cuenta la distribución histórica de esta especie y las características del agua donde se han recogido ejemplares vivos, parece que *U. mancus* es una especie propia de aguas duras, con concentraciones de calcio superiores a 100 mg/l. Aunque, como la mayoría de las náyades, requiere aguas limpias, puede vivir en acequias de riego.

Conservación: Con el nombre de *U. elongatulus* está amparada por las siguientes figuras de protección: Directiva Hábitats (Anexo V): Especies animales y vegetales de interés comunitario cuya recogida en la naturaleza y cuya explotación pueden ser objeto de medidas de gestión. Convenio de Berna (Anexo III): Especies protegidas que pueden ser objeto de explotación controlada, pero para las que está prohibido utilizar los métodos de caza/captura /pesca que se mencionan en el anexo IV. Catálogo Valenciano de Especies de Fauna Amenazada (Anexo I): En peligro de extinción. Catalogada en el Texto refundido de la Ley de Protección de los Animales de la Generalitat de Catalunya en la categoría de Especies protegidas de la fauna salvaje autóctona b. Invertebrados (Decreto legislativo 2/2008). Dado que el nombre *U. mancus* se asigna en la península Ibérica a las poblaciones anteriormente conocidas como *U. elongatulus*, toda la normativa que se aplica a esta especie debe ahora asignarse a *U. mancus*.

Como *U. mancus* está incluida en el Libro Rojo de los Invertebrados de España en la categoría Casi amenazado (Verdú y Galante, 2006).

Se trata de una especie en franca regresión, especialmente en el tramo medio del río Ebro, donde sus poblaciones están disminuyendo de forma alarmante, siendo la segunda náyade menos abundante después de *M. auricularia* (Araujo, Madeira y Ayala, 2007). Esta desaparición se debe a las afecciones antrópicas en el medio. También está desapareciendo del resto de los ríos mediterráneos ibéricos así como de la Albufera de Valencia. Las poblaciones de los principales canales que toman agua del Ebro (Imperial de Aragón y de Tauste) parecen ser las más abundantes y estructuradas, con presencia regular de ejemplares juveniles (Gómez y Araujo, 2008). La principal amenaza que actualmente se cierne sobre estas poblaciones son los cortes de agua que se suceden regularmente a lo largo del año. En primer lugar, porque en ocasiones se vacían demasiado los canales, siendo frecuentes la aparición de zonas en seco tanto en el centro del cauce como en los taludes; de este modo, los ejemplares que se encuentran en esas zonas quedan expuestos al aire libre en épocas en las que además son frecuentes las heladas, con lo que se pueden producir episodios de mortalidad. Y por otro lado, estos cortes de agua provocan la desaparición de los peces, que se van al río por los batideros, reduciéndose así las posibilidades de contacto entre náyades y peces. Además, a estas alteraciones del hábitat hay que sumarle la presencia en los canales de grandes densidades de especies de moluscos exóticos invasores (mejillón cebra -*Dreissena polymorpha*- y almeja asiática -*Corbicula fluminea*) que pueden agravar más la situación de esta especie. Por todo ello, se recomienda su inclusión en el nuevo Catálogo Español de Especies Amenazadas en la Categoría de Vulnerable.

(Página derecha) Figura 16. Náyades vivas. A, B: *Unio mancus*; C, D: *U. delphinus*; E, F: *Anodonta anatina*.

(Pagina direita) Figura 16. Náiades vivas. A, B: Unio mancus*; C, D:* U. delphinus*; E, F:* Anodonta anatina.

(Right page) Figure 16. Living naiads. A, B: Unio mancus*; C, D:* U. delphinus*; E, F:* Anodonta anatina.

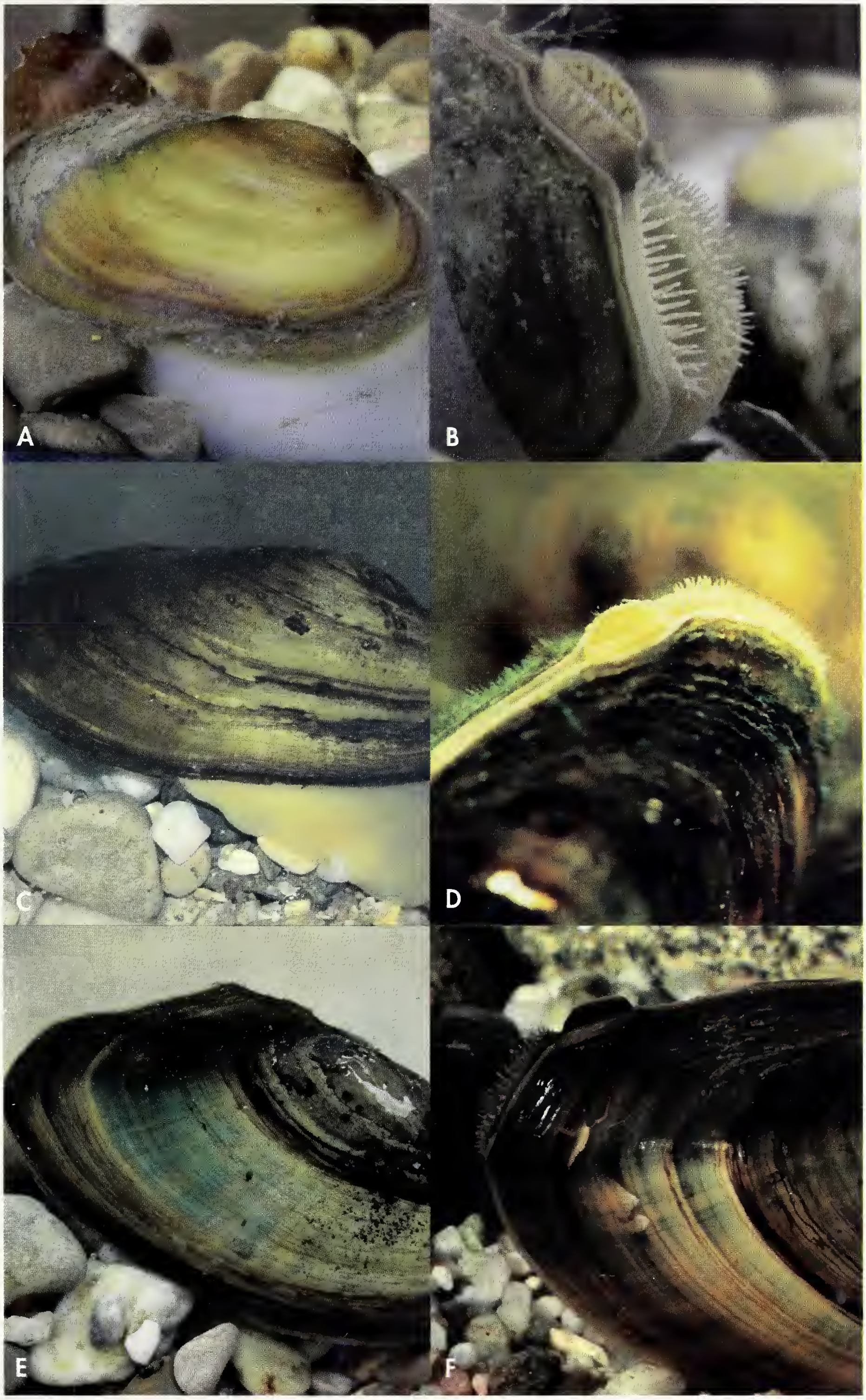
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Figura 17. Distribución de *Unio gibbus*.
Figura 17. Distribuição de Unio gibbus.
Figure 17. Distribution map of Unio gibbus.

Unio gibbus Spengler, 1793

Sinónimos:
Unio turdetanus Drouet, 1893. *Unionidae de l'Espagne*, 66-67; lam. I, fig. 4.
Unio tifleticus Pallary, 1923. *Bull. Soc. sc. Natur. Maroc*, 78. Figurado en Pallary, 1927. *J. de Conchyl.*: 71, lám. 7, figs. 1-2.
Unio (*Limniun*) *foucauldiana* Pallary, 1936. *J. de Conchyl.*: 63-64, lám. 4, fig. 2.
Unio (*Limniun*) *seurati* Pallary, 1936. *J. de Conchyl.*: 64-65, lám. 4, fig. 1.

Descripción original: *Unio gibbus* Spengler, 1793. *Skrifter af Naturhistorie Selskabet, Kjobenhavn*, 3 (1): 64.
Localidad tipo: Tranquebar, India. Sin duda un error (ver más abajo). Holotipo en el Zoological Museum of the University of Copenhagen. Nº: ZMUC BIV-434.
Ilustrado en: Haas, 1913: *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening I Kjobenhavn*, 65: 60, fig. 6; Knudsen *et al.*, 2003: *Steenstrupia*, 27 (2): 274, fig. 12. Ambas referencias ilustran el holotipo.

Comentario taxonómico: Curiosamente, SPENGLER (1793), que es quien describe la especie *U. gibbus*, indica que el ejemplar tipo procede de Tranquebar (India), pero ya HAAS (1913) advierte el error e indica que su procedencia es España y que se trata de la misma especie que el *U. turdetanus* de DROUET (1893). Años más tarde, el mismo HAAS (1969) considera tanto *U. gibbus* como *U. turdetanus* entre las sinonimias de *U. pictorum delphinus*, uno de los 13 taxa en los que este autor dividió *U. pictorum*, pero recientemente se ha demostrado que se trata de una especie distinta (ARAUJO *ET AL.*, 2009a).

En cuanto a las otras sinonimias de *U. gibbus*, *Unio tifleticus* fue sorprenden-

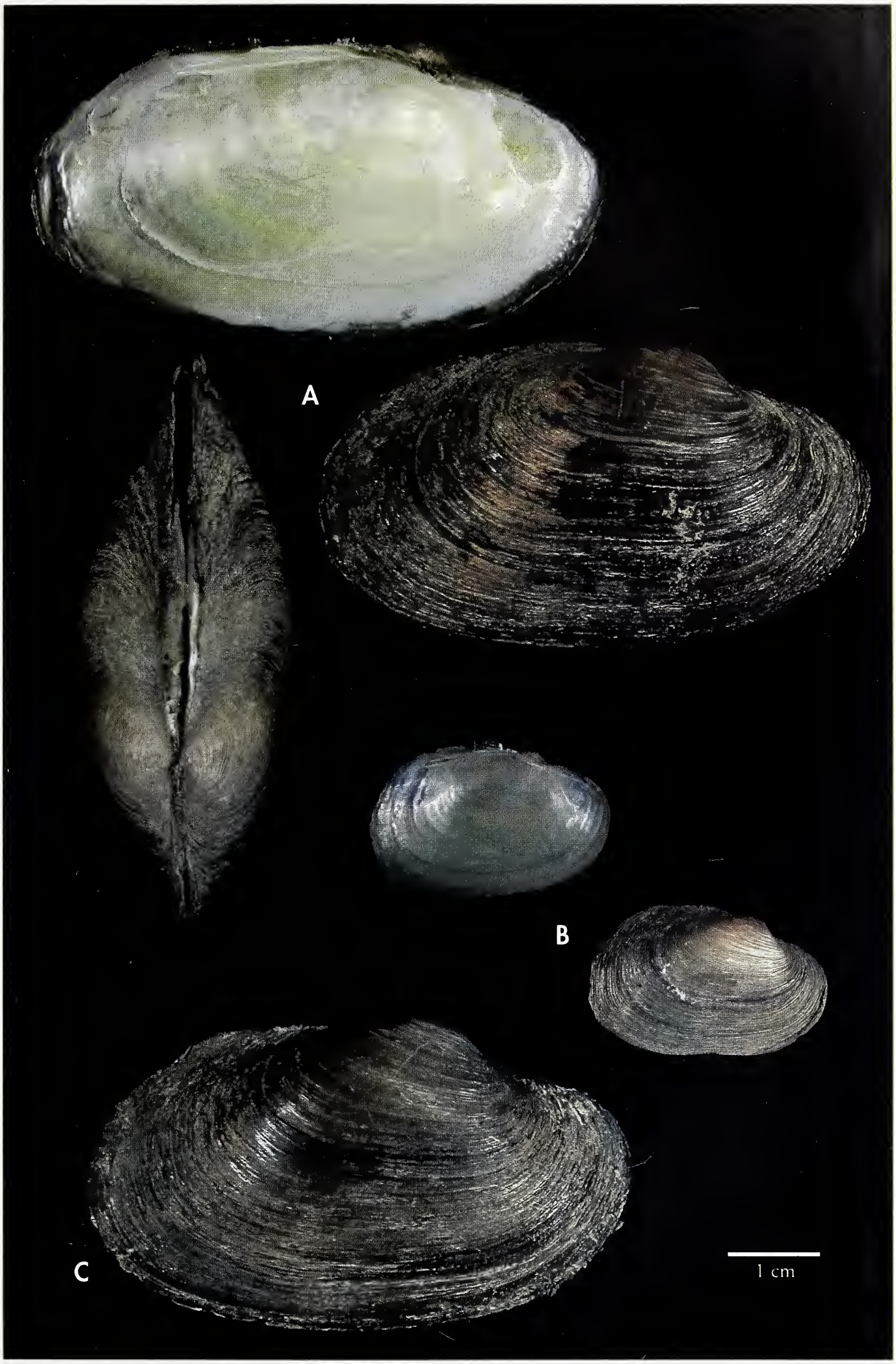


Figura 18. A-C: *Unio gibbus*, río Barbate (Cádiz). B: ejemplar juvenil.
Figura 18. A-C: Unio gibbus, *rio Barbate (Cádiz). B: juvenil.*
Figure 18. A-C: Unio gibbus, *Barbate river (Cádiz). B: juvenile specimen.*

temente sinonimizado por Haas (1969), y posteriormente por Daget (1998), con *Potomida littoralis fellmani* (Deshayes), la "raza" norteafricana de *P. littoralis*. Y en cuanto a *Unio* (*Limniun*) *foucauldiana* y *Unio* (*Limniun*) *seurati*, han sido considerados por Daget (1998) sinónimos del taxon norteafricano *U. elongatulus durieui* Deshayes, uno de los 17 taxa en los que Haas (1969) separó la especie mediterránea *U. elongatulus* C. Pfeiffer; no obstante, Haas (1969) no consideró en su libro ninguno de estos dos taxa.

Distribución: Ríos atlánticos del sur de la península Ibérica y Marruecos (Araujo et al., 2009a), también en los ríos del Mediterráneo marroquí, Argelia y Túnez. En la península (Fig. 17) sólo se han localizado ejemplares vivos en el río Barbate (Cádiz).

Drouet (1893) cita *U. turdetanus* en el arroyo salado cerca de Morón en Sevilla, donde no ha podido encontrarse por haberse modificado totalmente el hábitat. Pallary (1923, 1927, 1936) cita *Unio tifleticus* en el río Tiflet (cuenca del Sebou) Marruecos, *Unio* (*Limniun*) *foucauldiana* en el río Sous, al sur de Agadir (Marruecos) y *Unio* (*Limniun*) *seurati* en Chèlif (Argelia). Se han encontrado ejemplares de esta especie procedentes de Argelia en la colección del Museo Nacional de Historia Natural de Paris (Francia) y se ha tenido conocimiento de la presencia actual de la especie en ríos de Túnez (com. pers. Noureddine Khalloufi).

Morfología externa (Fig. 18): Concha ligeramente inflada, de silueta oval a redondeada y generalmente elevada en su parte dorsal posterior. La silueta recuerda a la de *Potomida littoralis*, sobre todo los ejemplares juveniles. Parte anterior redondeada en forma de arco de círculo y parte posterior también redondeada pero elevada en la región dorsal formando una quilla en la zona del ligamento. Concha delgada y ligera, con el periostraco en ocasiones desflecado en las zonas posterior y ventral de las valvas. Color verduzco (especialmente en los ejemplares marroquíes) o pardo, a menudo con bandas radiales más claras. Umbos redondeados y prominentes, nunca erosionados, y de color más claro que el resto de la concha. Se puede observar el gloquidio en el ápice del umbo a modo de protoconcha. Escultura umbonal (Fig. 13C) consistente en 2 ó 3 filas de fuertes tubérculos paralelos a las líneas de crecimiento de la concha, más patente en los ejemplares ibéricos. En los ejemplares juveniles los tubérculos posteriores se extienden en una línea diagonal que no se observa en los adultos. Valva izquierda con dos dientes pseudocardinales laminares, a menudo crenulados, que pueden estar juntos o separados, el posterior apuntado y más elevado, y dos dientes laminares laterales posteriores de longitud variable, el inferior siempre más elevado. Valva derecha con un diente pseudocardinal normalmente apuntado y plano y uno lateral posterior muy alto. Longitud máxima 85,6 mm.

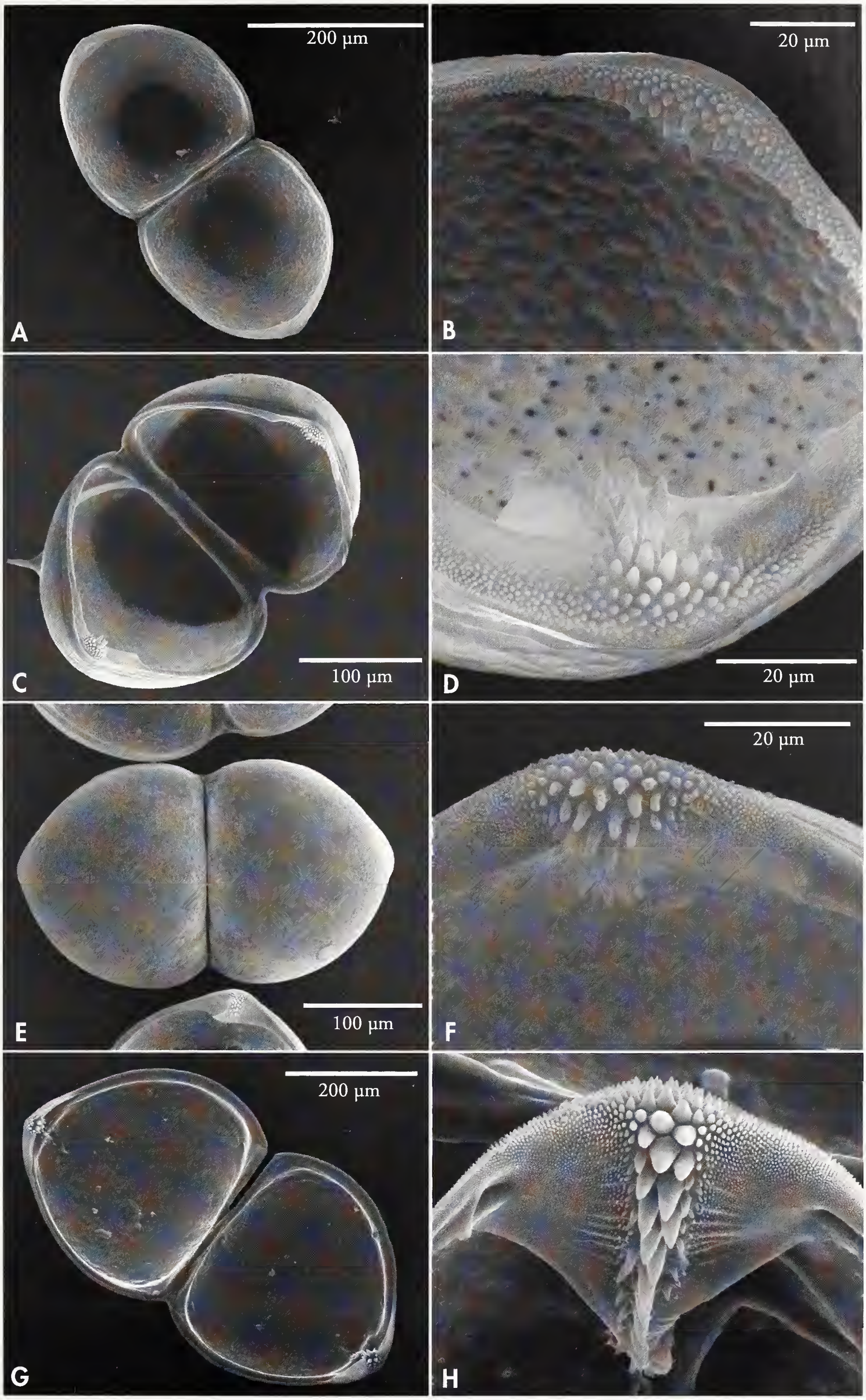
Papilas del sifón inhalante (Fig. 5F) de forma cónica y distribuidas en varias filas, a veces ramificadas.

Ciclo de vida: En el río Barbate las hembras están grávidas al final de febrero. Sin embargo, en Marruecos se han visto hembras con gloquidios maduros a principios de junio (Araujo et al., 2009a). En los ejemplares españoles toda la cámara de las branquias externas actúa como marsupio, pero en algunos ejemplares marroquíes se ha visto que las cámaras de ambas branquias pueden llenarse con gloquidios, algo excepcional en el género *Unio*. Los gloquidios

(Página derecha) Figura 19. Gloquidios. A, B: *U. gibbus*; C, D: *U. delphinus*; E, F: *U. tumidiformis*; G. H. *Anodonta anatina*.

(Pagina direita) Figura 19. Gloquídios. A, B: U. gibbus*; C, D:* U. delphinus*; E, F:* U. tumidiformis*; G, H:* Anodonta anatina.

(Right page) Figure 19. Glochidia. A, B: U. gibbus*; C, D:* U. delphinus*; E, F:* U. tumidiformis*; G, H:* Anodonta anatina.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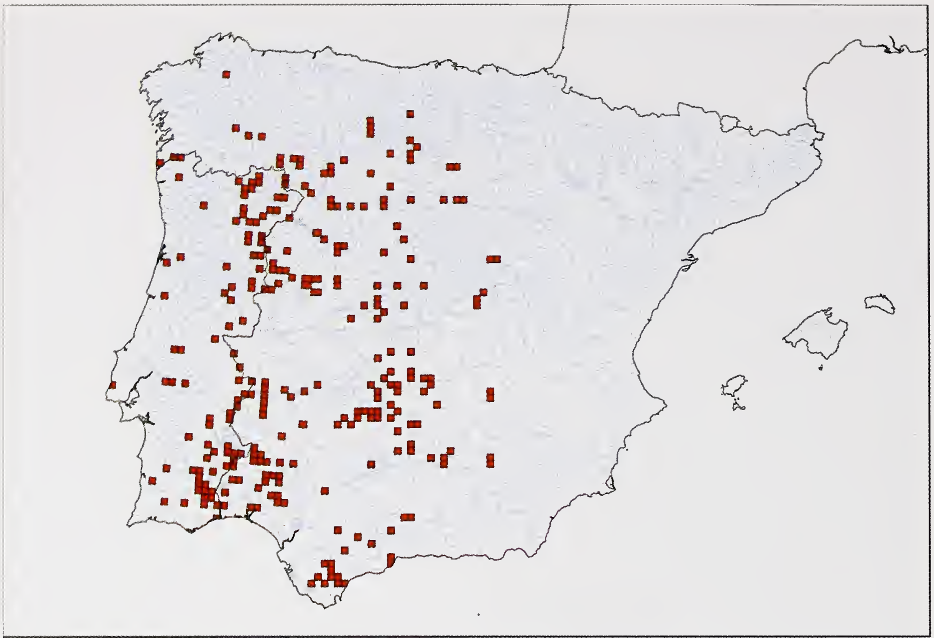

Figura 20. Distribución de *Unio delphinus.*
Figura 20. Distribuição de Unio delphinus.
Figure 20. Distribution map of Unio delphinus.

(Figs. 19A, B) en la población marroquí estudiada son triangulares, algo redondeados, con forma intermedia entre los propios de *Unio* y *Potomida*. Borde del gloquidio cubierto de pequeños abultamientos cuyo tamaño va aumentando hacia la parte ventral de la concha, aunque parece que sin llegar a formar las espículas y ganchos típicos del género. No obstante, en ejemplares de Túnez se ha visto que los gloquidios sí presentan gancho ventral (Khalloufi com. pers.) Dimensiones medias de los gloquidios (medidos al microscopio electrónico): longitud: 209.17 μm (ds = 2.83; n = 19), altura: 211 μm (ds = 3.93; n = 21), anchura: 67.67 μm (ds = 5.99; n = 3).

Se desconocen las especies de peces que pueden servir de hospedadores para sus gloquidios.

Hábitat: En fondos de arena y grava. Bajo la sombra de árboles en riberas y taludes. También entre piedras en zonas de rápidos. En España convive con *Potomida littoralis, Unio delphinus* y *Anodonta anatina,* mientras que en Marruecos se ha encontrado junto con *Unio delphinus* y *Potomida* sp.

Conservación: Dado que solamente se conoce de una localidad, *U. gibbus* es ahora mismo la especie de náyade más amenazada no sólo de la península Ibérica sino también de Europa. Además, dicha población ha sufrido muy recientemente gravísimos episodios de sequía que han podido mermar sus efectivos. Existen evidencias de que antes del drenado y desecación de la antigua laguna de la Janda (Cádiz), el hábitat de *U. gibbus* se extendía por una extensión mayor que la actual.

Pese a que su reconocimiento como especie válida es muy reciente, ya está catalogada (con el nombre de *Unio* sp.) en la categoría de En Peligro en el Libro Rojo de los invertebrados de Andalucía (BAREA *ET AL.*, 2008). Se recomienda su inclusión urgente en el nuevo Catálogo Español de Especies Amenazadas en la categoría En Peligro.

Unio delphinus Spengler, 1793

Sinónimos:
Unio hispanus Moquin-Tandon in Rossmässler, 1844. *Iconogr. Land Sussw. Moll.*, 2: 26, lám. 56, fig. 747.
Unio dactylus Morelet, 1845. *Moll. terr. fluv. Portugal*, 110, lám. 14, fig. 2.
Unio mucidus Morelet, 1845. *Descr. Moll. Portugal*, 111, lám. 14, fig. 3.
Unio lusitanus Drouet, 1879. *J. de Conch., Paris*, 327.
Unio hyperephanus Castro, 1885. *Bull. Soc. malac. France, Paris*, 2: 289.
Unio nevesi Castro, 1885. *Bull. Soc. malac. France, Paris*, 2: 291.
Unio simoesi Castro, 1885. *Bull. Soc. malac. France, Paris*, 2: 292.
Unio schousboei Bourguignat in Locard, 1889. *Conchyliol. portug.*, 250.
Unio subhispanus Castro in Locard, 1889. *Conchyliol. portug.*, 244.
Unio cameratus Drouet, 1893. *Unionidae de l'Espagne*, 45, lám. 2, fig. 8.
Unio limosellus Drouet, 1893. *Unionidae de l'Espagne*, 46, lám. 2, fig. 4.
Unio decurtatus Drouet, 1893. *Unionidae de l'Espagne*, 47, lám. 1, fig. 9.
Unio gravatus Drouet, 1893. *Unionidae de l'Espagne*, 49, lám. 2, fig. 6.
Unio chorellus Castro in Locard, 1899. *Conchyliol. portug.*, 227.
Unio barbozanus Castro in Locard, 1899. *Conchyliol. portug.*, 233.
Unio ocresanus Castro in Locard, 1899. *Conchyliol. portug.*, 236.
Unio chasmirhynchus Castro in Locard 1899. *Conchyliol. portug.*, 246.
Unio mundanus Castro in Locard 1899. *Conchyliol. portug.*, 247.
Unio euchasmus Castro in Locard 1899. *Conchyliol. portug.*, 249.
Unio tameganus Castro in Locard, 1899. *Conchyliol. portug.*, 221.
Unio oncomensis Locard, 1899. *Conchyliol. portug.*, 225.
Unio hypoxanthus Locard, 1899. *Conchyliol. portug.*, 226.
Unio chorellinus Locard, 1899. *Conchyliol. portug.*, 228.
Unio submucidus Locard, 1899. *Conchyliol. portug.*, 230.
Unio castroi Bourguignat in Locard, 1899. *Conchyliol. portug.*, 234.
Unio silvai Bourguignat in Locard, 1899. *Conchyliol. portug.*, 235.
Unio paulinoi Locard, 1899. *Conchyliol. portug.*, 242.
Unio taganus Servain in Locard, 1899. *Conchyliol. portug.*, 252.
Unio abrantesianus Castro in Locard, 1899. *Conchyliol. portug.*, 253.
Unio scalabisianus Castro in Locard, 1899. *Conchyliol. portug.*, 254.
Unio allenianus Castro in Locard, 1899. *Conchyliol. portug.*, 255.
Unio cyrtus Castro in Locard, 1899. *Conchyliol. portug.*, 257.
Unio sousanus Locard, 1899. *Conchyliol. portug.*, 258.
Unio novus Castro in Locard, 1899. *Conchyliol. portug.*, 258.
Unio neothaumus Castro in Locard, 1899. *Conchyliol. portug.*, 259.
Unio requienii taginus Kobelt, 1903. *Iconogr. Land Sussw. Moll.*, (2) 11: 28, lám. 279, fig. 1796.

Descripción original: *Unio delphinus* Spengler, 1793. *Skrifter af Naturhistorie Selskabet, Kjobenhavn*, 3 (1): 63.
Localidad tipo: Tranquebar, India. Sin duda un error (ver más abajo). Sintipo en el Zoological Museum of the University of Copenhagen. Nº: ZMUC BIV-433.
Ilustrado en: Haas, 1913. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening I Kjobenhavn*, 65: 59, fig. 5; Knudsen *et al.*, 2003. *Steenstrupia*, 27 (2): 273-274, fig. 11. Ambas referencias ilustran el sintipo.

Comentario taxonómico: Como en el caso de *U. gibbus*, SPENGLER (1793) indica que el ejemplar tipo de *U. delphinus* procede de Tranquebar (India), pero una vez más HAAS (1913) advierte el error y asegura que su procedencia es España y que se trata de la misma especie que el *U. hispanus* de Moquin Tandon. Años más tarde, el mismo HAAS (1969) considera tanto *U. delphinus* como *U. hispanus* entre las sinonimias de *U. pictorum delphinus*, uno de los 13 taxa en los que este autor dividió *U. pictorum*, pero recientemente se ha demos-

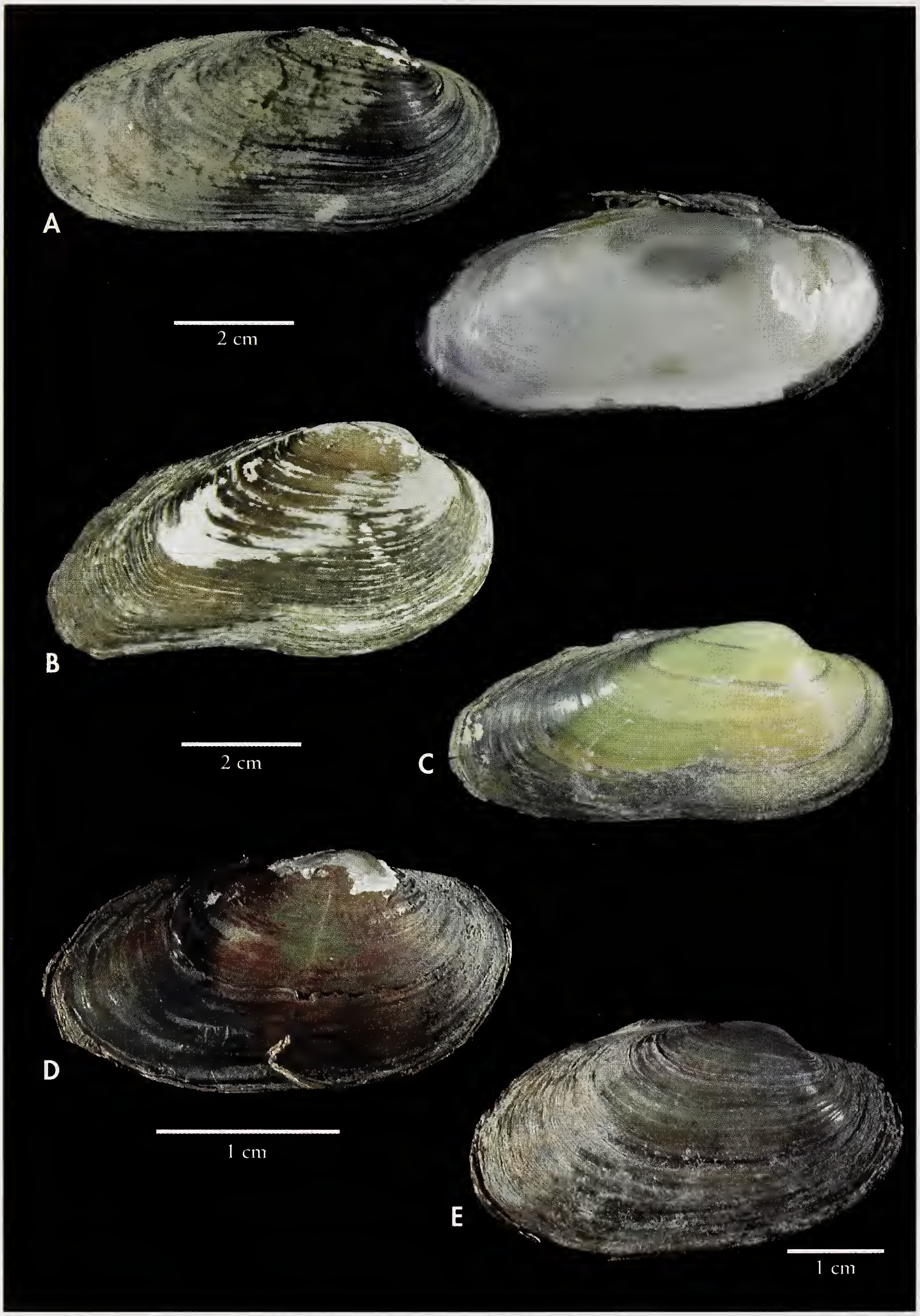

Figura 21. *Unio delphinus*. A: arroyo Landrinos (Toledo); B: lagunas de Ruidera (Albacete); C: embalse de Gasset (Ciudad Real); D: río Odelouca (Beja); E: río Guadalporcún (Sevilla).
Figura 21. Unio delphinus. *A: ribeira Landrinos (Toledo); B: lagoas de Ruidera (Albacete); C: albufeira de Gasset (Ciudad Real); D: rio Odelouca (Beja); E: rio Guadalporcún (Sevilla).*
Figure 21. Unio delphinus. *A: Landrinos srteam (Toledo); B: Ruidera lagoons (Albacete); C: Gasset impoundment (Ciudad Real); D: Odelouca river (Beja); E: Guadalporcún river (Sevilla).*

Figura 22. *Unio delphinus*. A: río Deza (Pontevedra); B: juvenil del embalse de Gasset (Ciudad Real).
Figura 22. Unio delphinus. *A: rio Deza (Pontevedra); B: juvenil da albufeira de Gasset (Ciudad Real).*
Figure 22. Unio delphinus. *A: Deza river (Pontevedra); B: juvenile from the Gasset impoundment (Ciudad Real).*

trado que *U. delphinus* es una especie diferente del *U. pictorum* europeo (REIS *ET AL*., en rev.).

De los 13 taxa en que HAAS (1969) divide la especie *U. pictorum*, solamente dos se distribuyen por la península Ibérica, *U. pictorum mucidus* Morelet, 1845 y *U. pictorum delphinus* Spengler, 1793, y ambos corresponden a *U. delphinus*. También es esta especie la que se ha citado en la península Ibérica como *Unio pictorum* (L. 1757) (VIDAL ABARCA Y SUÁREZ, 1985) o más recientemente, como *U.* cf. *pictorum* (REIS, 2006; REIS *ET AL*., en rev.).

Distribución: Ríos atlánticos de la península Ibérica y Marruecos. En la península (Fig. 20) es la especie de *Unio* más común y distribuida por estos ríos.

Morfología externa (Figs. 21, 22): es una de las especies de *Unio* más variables, presentando caracteres externos diferentes según el hábitat, lo que explica el gran número de sinónimos que tiene. Solamente por los caracteres de la concha es muy difícil de distinguir de la especie *Unio pictorum* que vive en el resto de Europa, e incluso puede ser confundido con la especie mediterránea española *U. mancus*, así como con otros taxones relacionados (por ej. *U. elongatulus*) (ARAUJO *ET AL*., 2005). Concha de silueta oval, generalmente alargada, aunque algunas poblaciones pueden presentar ejemplares redondeados o incluso de silueta casi rectangular. Parte anterior corta y redondeada, la posterior más alargada. En las cuencas de aguas moderadamente duras o duras el borde dorsal desciende bruscamente hacia la parte posterior, formando un ángulo marcadamente agudo (característica común en las poblaciones al sur del Tajo). En las cuencas de aguas blandas el borde dorsal es alto y la parte posterior redondeada, como en algunos ejemplares de *Unio tumidiformis* (característica común al norte del Tajo) y que correspondería al *Unio mucidus* de Morelet, 1845. Concha sólida, de color amarillo verdoso a marrón muy oscuro. Umbos redondeados, generalmente planos pero a veces prominentes, muy erosionados cuando viven en aguas ácidas. La escultura del umbo (Fig. 13B) consiste en tubérculos paralelos a las líneas de crecimiento de la concha y no siempre es bien visible. Valva izquierda con dos dientes pseudocardinales crenulados que pueden estar juntos en un solo diente o separados, y dos dientes laterales laminares, el inferior más alto. Valva derecha con un diente pseudocardinal casi siempre crenulado, un engrosamiento supracardinal (situado entre el borde dorsal de la concha y el diente pseudocardinal), exclusivo de esta especie, y un diente lateral posterior laminar. Los pseudocardinales de ambas valvas pueden ser muy robustos. Longitud máxima de la especie 10 cm.

Papilas del sifón inhalante (Figs. 5E, 16D) de forma cónica y distribuídas en varias filas.

Ciclo de vida: Se reproduce en verano. En el sur de la península (Río Barbate, Cádiz) se han visto hembras grávidas (con huevos) en febrero. La presencia de embriones y gloquidios maduros suele ocurrir entre mayo y julio en toda su área de distribución, desde Marruecos hasta el norte de España. En todos los ejemplares estudiados el marsupio se limita a toda la cámara de las branquias externas. Los gloquidios (Figs. 19C, D) son triangulares con un fuerte gancho ventral adornado con espículas. Dimensiones máximas de los gloquidios: (medidos con microscopio electrónico): longitud: 229 μm, altura: 213 μm, anchura: 151,8 μm.

Se desconocen los peces hospedadores de sus gloquidios, aunque teniendo en cuenta su amplia distribución y el rango de hospedadores de especies próximas como *Unio pictorum* y *Unio mancus* (BERRIE Y BOIZE, 1985; ARAUJO *ET AL*., 2005), debería incluir varias especies comunes en los ríos atlánticos de la península, por ejemplo: *Barbus* spp., *Chondrostoma* spp. (s.l.), *Gasterosteus aculeatus* L. y *Squalius* spp. entre otras.

Hábitat (Fig. 16C): En todo tipo de ríos y arroyos con agua permanente. Más común en riberas y taludes de arena bajo la sombra de los árboles, pero también en fondos de grava y cieno y en orillas soleadas. Puede aparecer en lagos (ej. Ruidera) y rara vez en embalses.

En ríos de aguas temporales suelen quedar poblaciones aisladas en las pozas que mantienen agua durante el

estiaje donde se mantienen refugiadas junto con los peces.

Conservación: Con el nombre de *U. pictorum* o *U.* cf. *pictorum*, está catalogado como Casi Amenazado en el Libro Rojo de los Invertebrados de España (VERDÚ Y GALANTE, 2006), De Interés Especial en el Catálogo Regional de Especies Amenazadas de Castilla-La Mancha y Vulnerable en el Catálogo Gallego de Especies Amenazadas y en el Libro Rojo de los Invertebrados de Andalucía (BAREA *ET AL.*, 2008).

Aunque es la especie de *Unio* más común de los ríos atlánticos de la península Ibérica, está en regresión, y sus poblaciones están desapareciendo de muchas localidades (ROLÁN, 1998; REIS, 2006; SOLER *ET AL.*, 2006; VELASCO Y ROMERO, 2006; BAREA *ET AL.*, 2008).

Dado que la tasa actual de desaparición de las náyades es catastrófica, y que cada vez son mayores las afecciones sobre los ríos donde habita *U. delphinus* (tanto naturales -sequías, riadas-, como artificiales -detracciones de agua, embalses, eutrofización-), se recomienda su inclusión en el nuevo Catálogo Español de Especies Amenazadas en la Categoría de Vulnerable.

Unio tumidiformis Castro, 1885

Sinónimos:

Unio batavus sensu Morelet, 1845. *Descript. des Moll. terr. et fluviat. du Portugal,* 109 (non *Unio crassus batavus* Maton and Rackett, 1807).

Unio sadoicus Castro, 1885. *Bull. Soc. Malac. France, Paris,* 2: 284.

Unio macropygus Castro, 1885. *Bull. Soc. Malac. France, Paris,* 2: 286.

Unio eupygus Castro, 1885. *Bull. Soc. Malac. France, Paris,* 2: 287.

Unio baeticus Kobelt, 1887. *Iconogr. Land Sussw. Moll.,* (2) 8: 55, lám. 89, fig. 495.

Unio conimbricus Kobelt, 1893. *Iconogr. Land Sussw. Moll.,* (2) 6: 99, lám. 180, fig. 1133.

Unio callypigus Drouët, 1893. *Unionidae de l'Espagne,* 65, lám. 2, fig. 2.

Descripción original: *Unio tumidiformis* Castro, 1885. *Bulletin de la Société Malacologique de France, Paris,* 2: 283.

Localidad tipo: Río Sado, Portugal. Sintipos en el Museu Zoológico Dr. Augusto Nobre, Porto, Portugal (2 ejemplares, colección Castro, lote Nº 47) y en el Muséum National d'Histoire Naturelle, Paris, Francia (21 ejemplares, Colección Locard, lote MNHN 20839).

Ilustrado en: Reis y Araujo (2009).

Comentario taxonómico: Esta especie ha sido identificada como *Unio crassus batavus* Maton and Rackett, 1807 (MORELET, 1845; AZPEITIA, 1933; HAAS, 1940, 1969) o más recientemente como *Unio* cf. *crassus* (REIS, 2006; REIS *ET AL.*, en rev.), pero se ha demostrado que se trata de una especie exclusiva de la península Ibérica (REIS Y ARAUJO, 2009) distinta del *U. crassus* que vive en el resto de Europa.

Distribución: Ríos atlánticos del suroeste de la península Ibérica (REIS Y ARAUJO, 2009). Actualmente sólo se conocen poblaciones en 3 cuencas hidrográficas (Fig. 23): Guadiana, Mira y Sado. No obstante, existe alguna cita en las cuencas del Tajo, Guadalquivir y Mondego. Aunque su presencia actual en el Guadalquivir fuera posible, en el Tajo y el Mondego es más improbable.

Morfología externa (Fig. 24): Es la náyade ibérica que presenta la concha de menores dimensiones en estado adulto (longitud máxima: 60 mm). Puede confundirse en algunos casos con *Unio delphinus*, pero un análisis detallado de sus caracteres puede revelar la diferencia entre ambas especies. Concha muy ancha, como indica su nombre *tumidiformis*, de forma oval, generalmente alargada, pero no tanto como en *Unio delphinus*, y con una proporción longitud/anchura raras veces superior a 2,5. Parte anterior muy corta y redondeada, la posterior alargada y alta, termi-

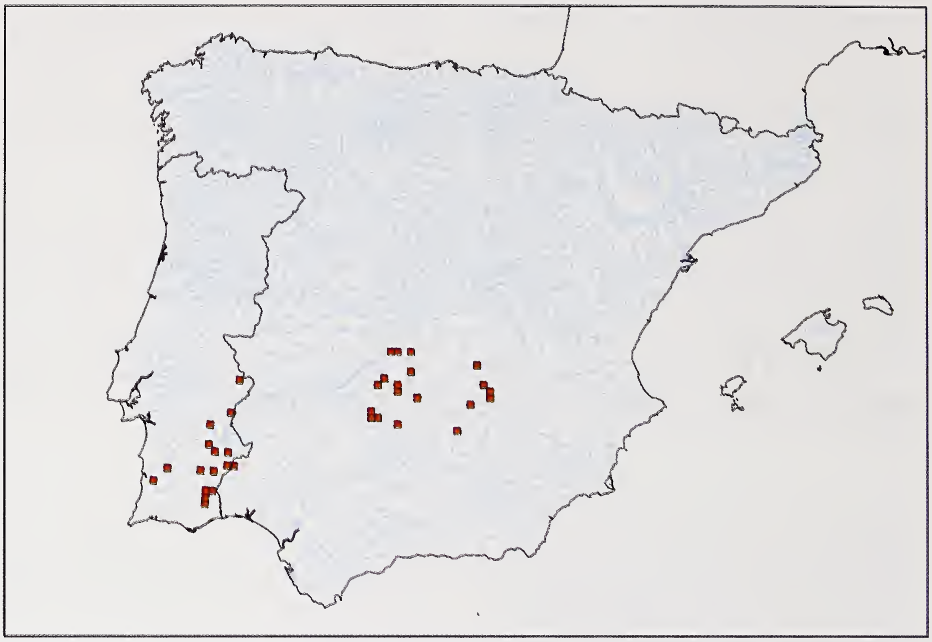

Figura 23. Distribución de *Unio tumidiformis*.
Figura 23. Distribuição de Unio tumidiformis.
Figure 23. Distribution map of Unio tumidiformis.

nando generalmente en una conexión redondeada entre el borde dorsal y ventral. En algunas poblaciones (por ej. en el río Sado, Portugal y en las lagunas de Ruidera, España) el borde dorsal posterior algo descendente formando un ángulo agudo. Concha de color amarillo verdoso a marrón muy oscuro, generalmente con unas rayas radiales amarillas, verdes o rojizas muy bien marcadas. Umbos redondeados y prominentes. La escultura del umbo (Fig. 13D) consiste en una serie de fuertes pliegues con forma de "w" paralelos a la longitud de la concha y apenas visibles cuando el umbo se encuentra erosionado. Valva izquierda con dos dientes pseudocardinales crenulados y dos dientes laterales laminares, el inferior más alto. Valva derecha con un diente pseudocardinal casi siempre crenulado y algo curvo, con la concavidad hacia el borde dorsal de la concha, y un diente lateral posterior laminar.

Papilas del sifón inhalante (Fig. 5G) de forma cónica y distribuidas en varias filas.

(Página derecha) Figura 24. *Unio tumidiformis*. A: río San Pedro (Beja); B, C: lagunas de Ruidera (Albacete); D: río Guadalmez (Ciudad Real); E: río Vascao (Beja/Faro); F: río Milagro (Ciudad Real); G: río Guadaira (Sevilla).

(Pagina direita) Figura 24. Unio tumidiformis. *A: rio São Pedro (Beja); B, C: lagoas de Ruidera (Albacete); D: rio Guadalmez (Ciudad Real); E: rio Vascão (Beja/Faro); F: rio Milagro (Ciudad Real); G: rio Guadaira (Sevilla).*

(Right page) Figure 24. Unio tumidiformis. *A: San Pedro river (Beja); B, C: Ruidera lagoons (Albacete); D: Guadalmez river (Ciudad Real); E: Vascao river (Beja/Faro); F: Milagro river (Ciudad Real); G: Guadaira river (Sevilla).*

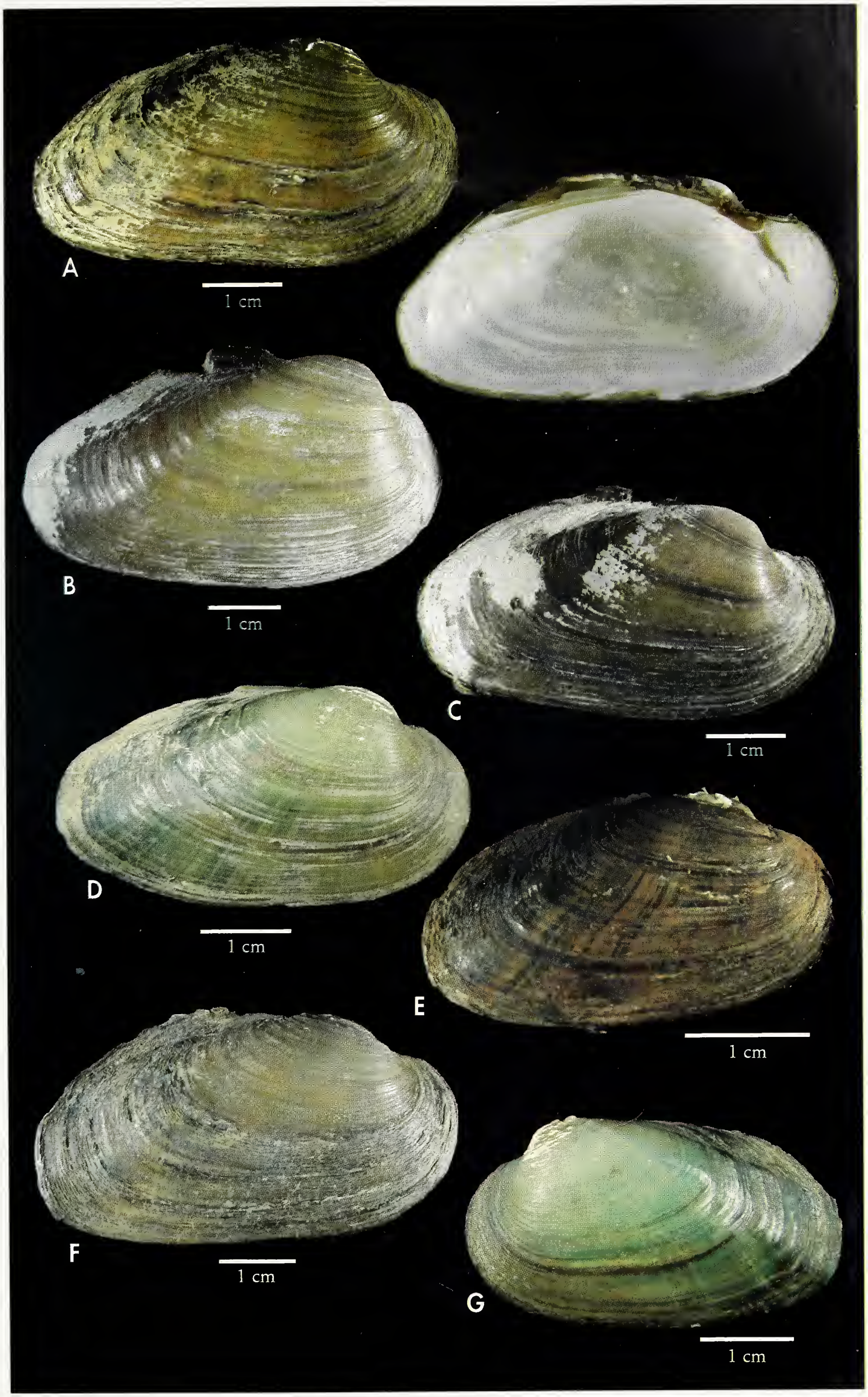
A
1 cm
B
1 cm
C
1 cm
D
1 cm
E
1 cm
F
1 cm
G
1 cm

Figura 25. Distribución de *Unio ravoisieri*.
Figura 25. Distribuição de Unio ravoisieri.
Figure 25. Distribution map of Unio ravoisieri.

Ciclo de vida: Se reproduce en verano. La presencia de embriones y gloquidios maduros suele ocurrir entre abril y julio en toda su área de distribución (Reis y Araujo, 2009). En la población del río Vascão (cuenca del Guadiana, Portugal) se han encontrado gloquidios entre marzo y agosto de 2007. En todos los ejemplares estudiados el marsupio se limita a toda la cámara de las branquias externas. Los gloquidios (Figs. 19E, F) son triangulares, con un fuerte gancho ventral adornado con espículas. Dimensiones máximas de los gloquidios: (medidos con microscopio electrónico): longitud: 202 μm, altura: 158 μm, anchura: 144 μm (Reis y Araujo, 2009).

Se han probado diferentes especies de peces como potenciales hospedadores en experimentos en cautividad, pero sólo se han obtenido juveniles con ejemplares del género *Squalius*: *S. alburnoides* (Steindachner), *S. aradensis* (Coelho, Bogutskaya, Rodrigues y Collares-Pereira), *S. carolitertii* (Doadrio), *S. pyrenaicus* (Günther) y *S. torgalensis* (Coelho, Bogutskaya, Rodrigues y Collares-Pereira). Cualquier especie atlántica perteneciente a este género parece ser un buen hospedador para los gloquidios de *Unio tumidiformis*, independientemente de que ocurra naturalmente en simpatría con el bivalvo.

Hábitat: Generalmente en ríos de orden mediano con régimen de tipo mediterráneo temporal. En riberas y taludes de arena y cieno con vegetación bajo la sombra de los árboles. Puede aparecer en lagos (ej. Ruidera).

En épocas de estiaje de los ríos suelen quedar poblaciones aisladas en las pozas que mantienen agua donde se refugian junto con los peces. El resto del año suele vivir muy enterrada en el cieno o la arena.

Conservación: Catalogada como Vulnerable en el Libro Rojo de los Invertebrados de Andalucía (Barea *et al.*, 2008). Con el nombre de *U. crassus* está catalogada como Vulnerable en el Libro

Rojo de los Invertebrados de España (Verdú y Galante, 2006). El nombre *U. tumidiformis* sustituye en la península Ibérica a *U. crassus*, especie incluida en los anexos II y IV de la Directiva Hábitat, por lo que mantiene este estatuto de protección hasta que se revise la Directiva.

Unio tumidiformis presenta varias características que justifican una atención particular para su conservación: 1. Es una especie endémica limitada en la actualidad a las cuencas del Guadiana, Mira y Sado. 2. Sus poblaciones se encuentran muy dispersas y aisladas, estando formadas en ocasiones por muy pocos ejemplares. 3. En toda su área de distribución la sequía presenta una amenaza creciente capaz de eliminar rápidamente las poblaciones. De hecho, se conoce por lo menos una población que hasta 2005 contaba con miles de ejemplares y reclutamiento de juveniles que ha desaparecido casi por completo tras la sequía de dicho año.

Se recomienda su inclusión en el Catálogo Español de Especies Amenazadas en la categoría de Vulnerable.

Unio ravoisieri Deshayes, 1847

Sinónimos

Unio moreleti Deshayes, 1847. *Hist. Moll. Algérie*, lám. 109, figs. 1-4.
Unio penchinatianus Bourguignat, 1865. *Moll. nov. litig. peu connus*, 2 série (XVII): 342-343, lám. 21, figs. 1-7.
Unio tafnanus Kobelt, 1884. *Iconogr. Land-Sussw. Moll.*, (2)1: 66, lám. 28, fig. 216.
Unio ravoisieri var. *isserica* Kobelt, 1884. *Iconogr. Land-Sussw. Moll.*, (2)1: 65, lám. 28, fig. 215.
Unio medjerdae Kobelt, 1886. *Iconogr. Land-Sussw. Moll.*, (2)2: 23, lám. 42, fig. 257-259.
Unio micelii Kobelt, 1886. *Iconogr. Land-Sussw. Moll.*, (2)2: 24, lám. 43, fig. 260-261.
Unio delevieleusae Hagenmüller in Bourguignat, 1887. *Prodr. Malacol. Tunisie*; 162.
Unio doumeti Bourguignat, 1887. *Prodr. Malacol. Tunisie*; 163.

Descripción original: *Unio ravoisieri* Deshayes, 1847. *Histoire naturelle des mollusques. In: Exploration scientifique de l'Algérie. Paris*, lám. 108, figs. 4-7.
Localidad tipo: Lago Oubeira, La Calle (hoy El Kelaa), Argelia.
Ilustrado en: Deshayes, 1847. *Histoire naturelle des mollusques. In: Exploration scientifique de l'Algérie*, lám. 108, figs. 4-7; Bourguignat, 1864. *Malacologie de l'Algérie*, lám. 20, figs. 5-10; Bourguignat, 1865. *Mollusques noveaux, litigieux ou peu connus*, 2 série (XVII), lám. 21, figs. 1-7.

Comentario taxonómico: La especie *U. ravoisieri* ha sido considerada por Haas (1969) como especie modelo del taxon norteafricano *Unio pictorum ravoisieri* Deshayes, pero probablemente se trata de una especie más próxima al grupo *elongatulus* que al grupo *pictorum* (*sensu* Haas).

Por otra parte, Haas (1969) dividió la especie mediterránea *U. elongatulus* en 17 taxa diferentes, uno de los cuales, *U. elongatulus penchinatianus* Bourguignat, viviría en los ríos del noreste de España hasta el Ebro (éste incluido) y el lago de Bañolas. Recientes estudios (Toledo *et al.*, datos no publicados) demuestran que dentro de este taxon se incluyen dos especies diferentes: *U. mancus* (en los ríos mediterráneos ibéricos, ver comentario taxonómico de *U. mancus*) y *U. ravoisieri* (en la cuenca del Fluviá y el lago de Bañolas). Hemos comprobado que esta última especie, descrita por Bourguignat como *U. penchinatianus* en Bañolas, ya había sido previamente descrita por Deshayes en ríos argelinos con el nombre de *U. ravoisieri*.

Altaba (1991) cita *U. e. penchinatianus* como especie endémica del lago de Bañolas, pero no considera la presencia de *U. mancus* en esta localidad. Tampoco Haas (1916) en su estudio sobre las náyades de dicho lago consideró la presencia de dos especies diferentes de *Unio*. Hoy sí sabemos que en Bañolas *U. ravoisieri* y *U. mancus* viven juntas y no son siempre fáciles de distinguir por su aspecto externo. Por ello, Araujo *et al.*

(2005) consideraron la cita de ALTABA (1991) una posible confusión con *U. mancus*. *Unio ravoisieri* ha sido también confundida (ALTABA, 1991; COMAS Y MALLARACH, 2004) con *U. aleroni*. Como ya se ha comentado, los recientes análisis moleculares de ejemplares de la localidad tipo de *U. aleroni* (río Basse al sur de Francia), han confirmado que se trata de ejemplares de *U. mancus* (Toledo *et al*., datos no publicados).

Distribución: En la península Ibérica (Fig. 25) restringida al lago de Bañolas y cuenca del Fluviá, donde se conoce del río Ser (Toledo *et al*., datos no publicados). Se desconoce si las citas de *U. aleroni* de la cuenca del Llobregat (COMAS Y MALLARACH, 2004) pertenecen en realidad a *U. ravoisieri* o a *U. mancus*.

Es una especie común en el norte de África al este del río Moulouya (Argelia y Túnez).

Morfología externa: Los ejemplares del río Ser (Fig. 26A) presentan una concha muy fina, pequeña, siempre alargada y comprimida, de color pardo, a menudo verde o incluso amarillento, con los anillos de crecimiento externos muy juntos. Bordes dorsal y ventral paralelos, el dorsal a veces ligeramente ascendente hacia la región posterior. Umbos planos, muy poco prominentes. Escultura del umbo (Fig. 13E) formada por dos filas de tubérculos a menudo muy marcados y picudos, aunque no siempre presente (puede faltar incluso en ejemplares con el umbo no erosionado). Rara vez mayor de 60 mm aunque hay ejemplares hasta de 95 mm. Una de las principales características de esta especie es la forma redondeada del borde anterodorsal de la concha, que dibuja un arco muy patente, aunque este carácter se encuentra también en algunas poblaciones de *U. mancus*. Ligamento fino. Charnela muy débil y delgada, con los dientes pseudocardinales pequeños y laminares, los de la valva izquierda generalmente fusionados en uno.

La forma de las conchas de los ejemplares de Bañolas (Fig. 26B) es bastante diferente, como suele ocurrir con las poblaciones que viven en lagos (ej. *U. tumidiformis* de las Lagunas de Ruidera). Tamaño muy grande (hasta 105 mm), con la concha mucho más espesa, inflada y sólida que en los ejemplares de río, y de color pardo amarillento, nunca verde. La región posterior aparece siempre cubierta de creta (Haas, 1916). Silueta cuadrangular muy característica, con el umbo retrasado, de forma que la parte anterior es muy corta y la posterior muy alargada. Charnela y ligamento muy desarrollados; dientes pseudocardinales muy fuertes, aserrados y separados en la valva izquierda. Escultura del umbo similar a la de los ejemplares de río.

En sus localidades ibéricas, *U. ravoisieri* solamente puede confundirse con *Unio mancus*. En el lago de Bañolas las dos especies son bastante difíciles de distinguir por sus caracteres externos.

Papilas del sifón inhalante (Fig. 5H) de forma cónica y distribuidas en varias filas.

Ciclo de vida: Las branquias externas de las hembras del río Ser aparecen cargadas de huevos entre los meses de junio y julio. Se desconoce la morfología del gloquidio y sus posibles peces hospedadores, aunque se han citado las especies *Barbus meridionalis* Risso y *Leuciscus cephalus* L. (GENERALITAT DE CATALUNYA, 2004). En ríos de Túnez se ha visto que la liberación de las larvas se produce en marzo.

Hábitat: En fondos de grava y cieno de los cursos medianos y bajos de ríos pequeños y poco profundos. Generalmente muy escondido, clavado en las riberas y taludes a la sombra, también entre las raíces de los árboles. En el lago de Bañolas muy enterrado en el sedimento del fondo.

Conservación: Al tener una distribución tan restringida, la salud de sus poblaciones depende de la de las pocas masas de agua donde habita. Además, es una especie muy poco abundante y muy difícil de localizar. La población del lago de Bañolas requiere también una protección urgente ante la amenaza de desaparición fundamentalmente por la sustitución de peces nativos por peces exóticos. Se recomienda su inclusión en el nuevo Catálogo Español de Especies Amenazadas en la Categoría En Peligro.

Figura 26. *Unio ravoisieri*. A: río Ser (Gerona); B: lago de Bañolas (Gerona).
Figura 26. Unio ravoisieri. *A: rio Ser (Gerona); B: lago de Bañolas (Girona).*
Figure 26. Unio ravoisieri. *A: Ser river (Gerona); B: Bañolas lake (Gerona).*

Figura 27. Distribución de *Anodonta cygnea.*
Figura 27. Distribuição de Anodonta cygnea.
Figure 27. Distribution map of Anodonta cygnea.

Anodonta cygnea (Linnaeus, 1758)

Sinónimos: El número de sinonimias de *A. cygnea* se cuenta por cientos. HAAS (1969) por ejemplo, cita 542. El problema es que tanto en este caso como en el listado de sinonimias que da SIMPSON (1900), también se incluyen las correspondientes a la otra especie europea *A. anatina.* Debido a esta dificultad y para evitar mayor confusión, solamente asignamos los sinónimos que hemos podido comprobar a partir de la iconografía (SCHRÖTER, 1779; DROUET, 1893; AZPEITIA, 1933) y de la consulta de los sintipos conservados en el Museu Zoológico Dr. Augusto Nobre (Porto, Portugal) y en el Muséum National d'Histoire Naturelle (París, Francia).

Mya arenaria Schröter, 1779 (non Linnaeus, 1758). *Gesch. Flussconch.*: 165, lám. 2, fig. 1.
Anodonta oblonga Millet, 1833. *Mém. Soc. Agric. Sci. Angers,* 1 (3): 242, lám. 12, fig. 1.
Anodonta gallica Bourguignat, 1881. *Matér. Moll. Acéph. Syst. Europ.*, 123.
Anodonta enhydra Castro, 1885. *Bull. Soc. Malac. France, Paris,* 2: 279.
Anodonta apala Castro in Locard, 1899. *Arch. Mus. Hist. Nat. Lyon,* 7: 265.
Anodonta pelophila Castro in Locard, 1899. *Arch. Mus. Hist. Nat. Lyon,* 7: 268.

Descripción original: *Mytilus cygneus* Linnaeus, 1758. *Systema Naturae,* 10. Aug.: 706, Nr. 218.
Ilustrado en: Lister, 1678. *Historiae Animalium Angliae, etc, London,* T. 2, fig. 29; Lister, 1685. *Appendicis ad Historiam Animalium Angliae, London,* figs. 2 y 3; Lister, 1770. *Historiae sive sinopsis methodicae Conchyliorum et, Oxford,* T. 153, fig. 8; Gualtieri, 1742. *Index testarum Conchyliorum quae adservantur in Museo Nicolai Guialtieri, etc, Florencia,* T. 7, fig. F; Schröter, 1779. *Die Geschichte der Flüssconchylien, etc. Halle,* lám. 2, fig. 1; Rossmässler, 1836. *Iconographie der Land und Süsswasser Mollusken,* IV:1-27, lám. 19, fig. 280.

Comentario taxonómico: La especie *A. cygnea* ha sido confundida innumerables veces con *A. anatina,* siendo ambas muy polimórficas y difíciles de distinguir. Aunque HAAS (1969) consideró que en Europa, y por lo tanto en la península

Ibérica, sólo había una especie de *Anodonta*, *A. cygnea*, esto no es cierto.

Existen varias ilustraciones de esta especie anteriores a su descripción. No obstante, gracias a HANLEY (1855) sabemos que el ejemplar ilustrado por ROSSMÄSSLER (1836, pl. 19, fig. 280) como *A. cygnea* var. *Cellensis* es idéntico al tipo descrito por Linneo como *A. cygnea*. Curiosamente, ROSSMÄSSLER (1836) incluye como primera sinonimia de esta especie a *Mytilus cellensis* Schröter, 1779, t. 2, fig. 1, pero hemos comprobado, como probablemente ya hizo BOURGUIGNAT (1881, en AZPEITIA, 1933), que SCHRÖTER (1779) en ningún momento describe esa especie en su libro. No obstante, es necesario añadir que en la citada figura de SCHRÖTER (1779) sí se ilustra una auténtica *A. cygnea* pero con el nombre de *Mya arenaria* L.

Distribución: Las únicas poblaciones que se conocen en la península Ibérica (Fig. 27) están en las lagunas litorales de agua dulce del centro de Portugal entre Aveiro y Coimbra (REIS, 2006). En el año 2008 también se localizaron ejemplares en la laguna de Arbucies (Gerona), aunque han debido desaparecer tras las obras realizadas para su modernización (Araujo, obs. pers.). Probablemente esta especie no se distribuye de forma natural en la península Ibérica y su presencia es debida a la introducción de ejemplares o de peces infectados con gloquidios procedentes de Europa central (REIS *ET AL.*, en rev.), ya que las lagunas donde ha aparecido son hábitats muy modificados por el hombre. No obstante, existen dos citas antiguas de la especie que parecen fiables: una en el río Mondego (LOCARD, 1899), en el extremo sur de su zona de ocurrencia actual, y otra en el río Palmones (Cádiz), en el sur de la península Ibérica (AZPEITIA, 1933). Aparte de éstas y otras citas de CASTRO (1873) y LOCARD (1899) en las lagunas donde existe actualmente y en la vecina laguna de Ervedal, otras citas que se puedan localizar en la bibliografía se refieren a *A. anatina*.

Morfología externa (Figs. 28, 29): Concha muy grande, hasta 170 mm, y muy frágil, sin dientes en la charnela. Color pardo amarillento a verduzco. Aunque puede ser fácilmente confundida con *A. anatina*, es más alargada y con los bordes dorsal y ventral muy rectos y paralelos. Borde posterior generalmente muy alargado, a veces en pico. La escultura del umbo, cuando está presente, se limita a una serie de estrías concéntricas elevadas que siguen el dibujo de las líneas de crecimiento, siendo a veces discontinuas y a veces bifurcadas y discurriendo de borde a borde del umbo, lo que la distingue de *A. anatina*, cuya escultura, aunque similar, es siempre ondulada y a menudo no alcanza los bordes de la concha (KENNARD, SALISBURY Y WOODWARD, 1925). Otras dos características de *A. cygnea* son el umbo muy plano, de forma que éste nunca es visible mirando la concha por la cara interna, y el ligamento largo y oculto.

Ciclo de vida: En la única población ibérica estudiada todos los ejemplares son hermafroditas y liberan los gloquidios en primavera (Lima, com. pers.). Solamente las branquias externas actúan como marsupio. Es una especie "long-term brooder", es decir, que mantiene los gloquidios en las branquias durante todo el invierno. En Inglaterra los gloquidios maduros aparecen en otoño y son retenidos en la branquia materna hasta la próxima primavera (WOOD, 1974; ALDRIDGE, 1999), como también ocurre en Italia (GIUSTI, CASTAGNOLO, MORETTI Y RENZONI, 1975).

El gloquidio de *A. cygnea* es grande (longitud 350 μm, altura 350 μm) y triangular, con una característica espina en forma de gancho en el ápice ventral que a su vez está armada de numerosas espículas en toda su longitud (NAGEL, 1999; HOGGARTH, 1999). Los gloquidios se fijan a los peces en los filamentos branquiales, opérculos, boca, ojos y aletas, fundamentalmente entre los meses de noviembre y mayo. Los peces hospedadores conocidos son: *Gasterosteus aculeatus* L, *Atherina boyeri* Risso, *Tinca tinca* L., *Lepomis gibbosus* L., *Perca fluviatilis* L. y *Esox lucius* L. (WOOD, 1974; GIUSTI *ET AL.*, 1975; DARTNALL Y WAKEY, 1979), de los que sólo los tres primeros son autóctonos de la península Ibérica.

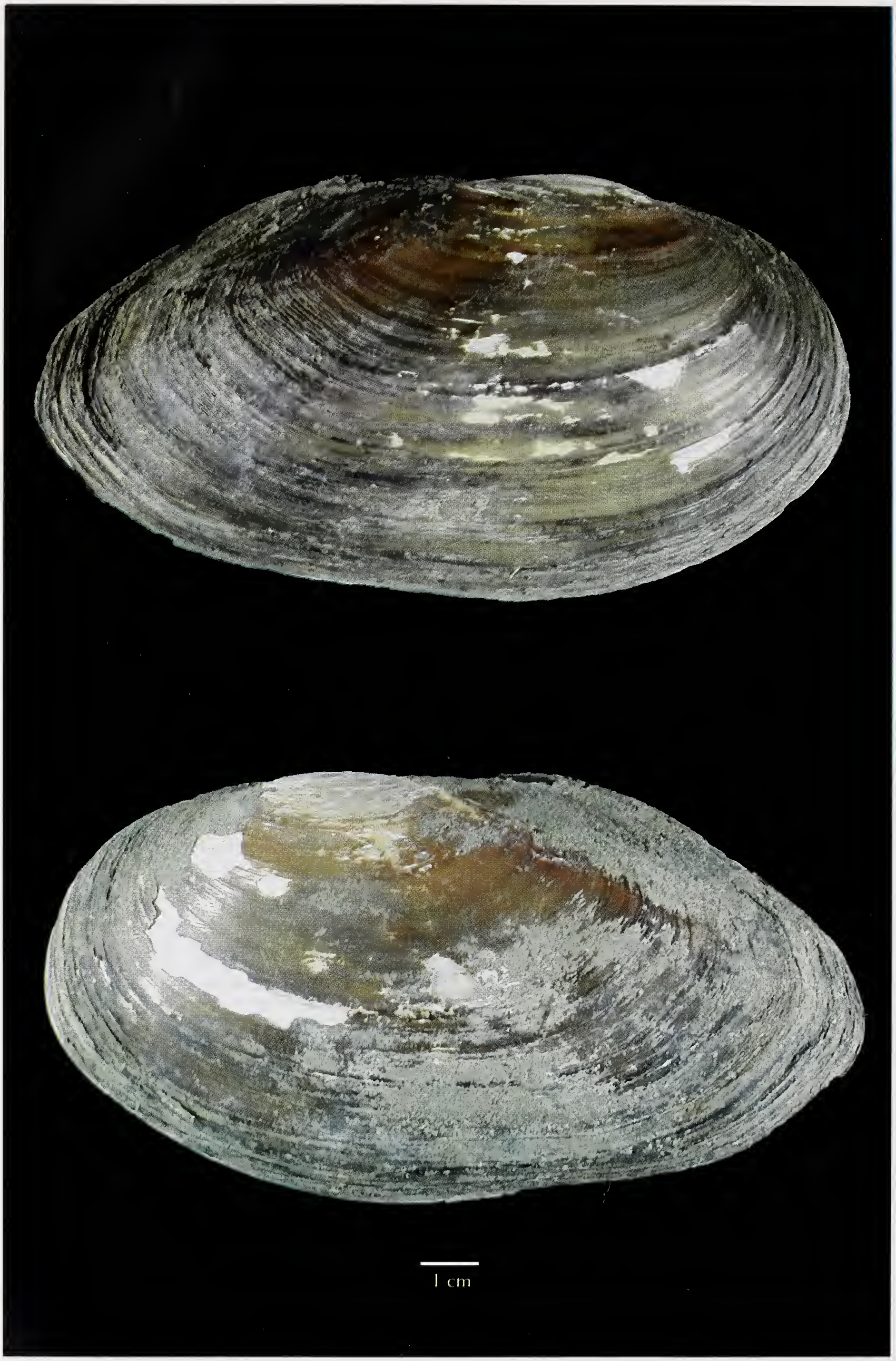

Figura 28. *Anodonta cygnea*. Pateira de Fermentelos, Aveiro.
Figura 28. Anodonta cygnea. *Pateira de Fermentelos, Aveiro.*
Figure 28. Anodonta cygnea. *Pateira de Fermentelos, Aveiro.*

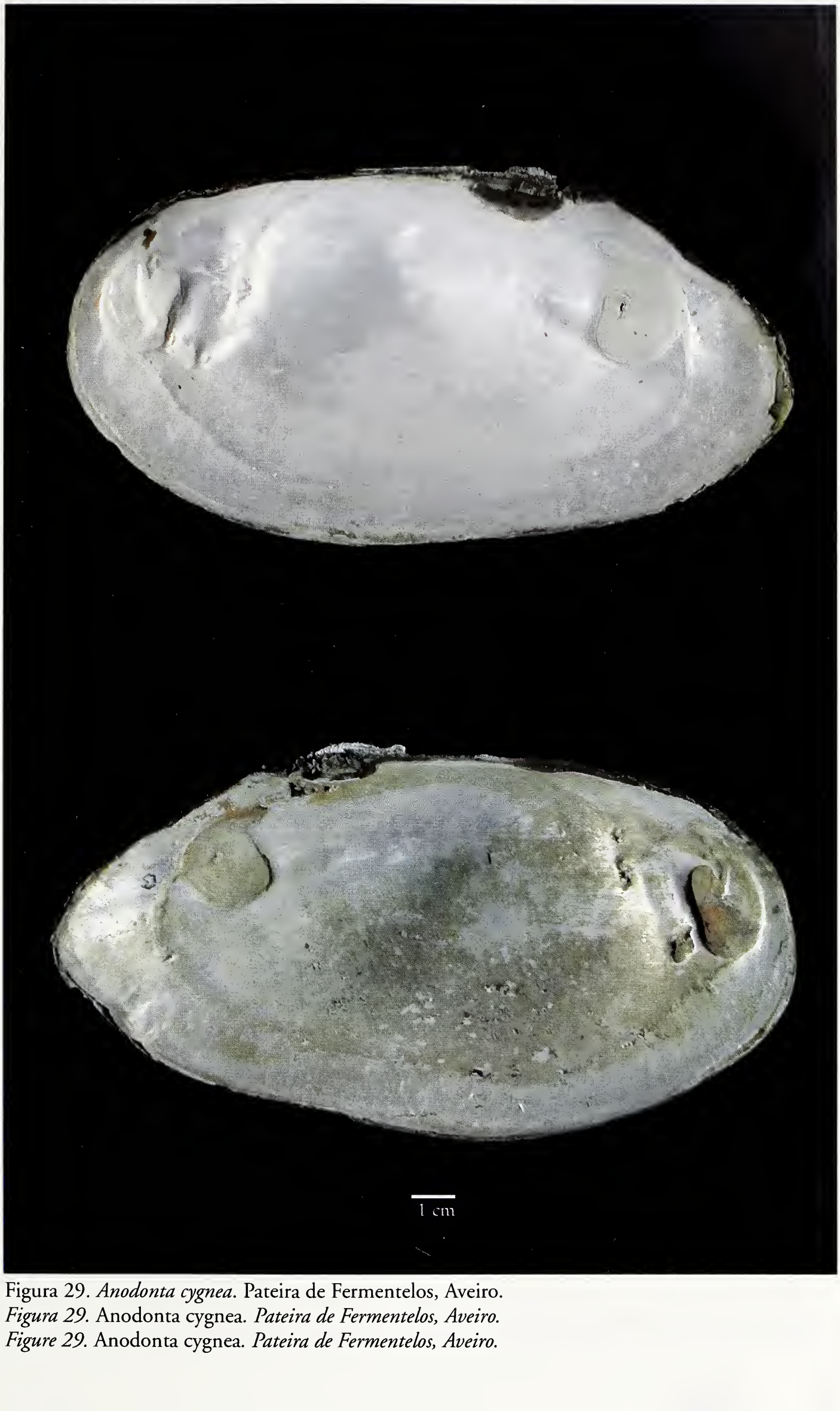

Figura 29. *Anodonta cygnea*. Pateira de Fermentelos, Aveiro.
Figura 29. Anodonta cygnea. *Pateira de Fermentelos, Aveiro.*
Figure 29. Anodonta cygnea. *Pateira de Fermentelos, Aveiro.*

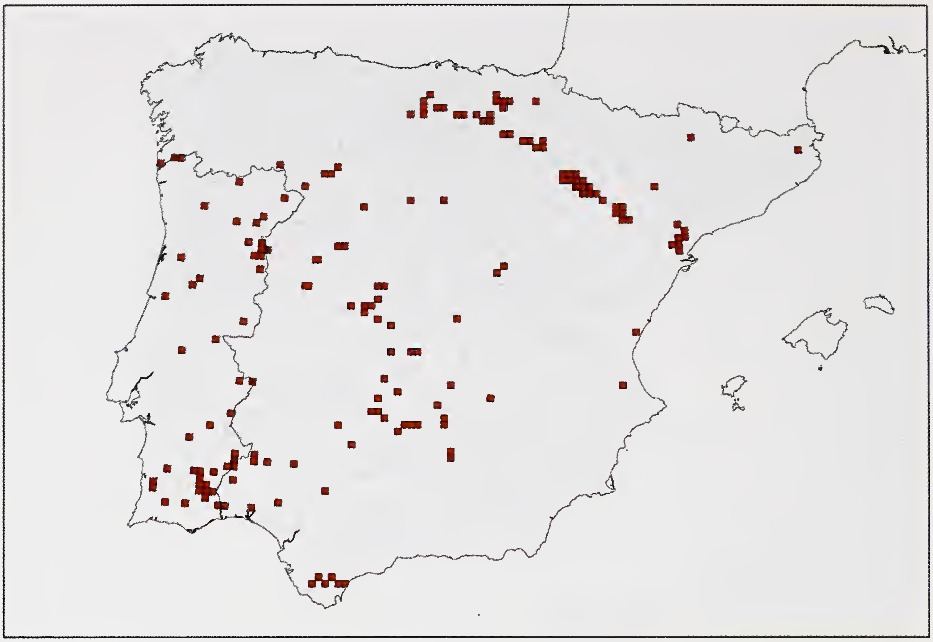

Figura 30. Distribución de *Anodonta anatina*.
Figura 30. Distribuição de Anodonta anatina.
Figure 30. Distribution map of Anodonta anatina.

Hábitat: En la península sólo se ha encontrado en lagunas de aguas poco profundas (menos de 5 metros), donde vive semi-enterrada en un cieno muy fino y distribuida prácticamente por toda la superficie del fondo.

Conservación: Catalogada en la categoría de Casi Amenazada en el Libro Rojo de los Invertebrados de España (VERDÚ Y GALANTE, 2006) y en la de Datos Insuficientes en el Libro Rojo de los Invertebrados de Andalucía (BAREA *ET AL.*, 2008). Antes de proponer alguna medida de conservación para esta especie es necesario averiguar si se distribuye de forma natural por la península Ibérica.

Anodonta anatina (Linnaeus, 1758)

Sinónimos: Como ocurre con la especie anterior, el número de sinonimias de *A. anatina* es elevadísimo, estando además generalmente mezclados los sinónimos de esta especie con los de *A. cygnea*. Debido a esta y otras dificultades (ver apartado Comentario taxonómico), y para evitar mayor confusión, solamente consideramos como sinónimos válidos las especies ibéricas que hemos podido comprobar a partir de la iconografía (DROUET, 1893; AZPEITIA, 1933).

Anodonta regularis Morelet, 1845. *Descript. des Moll. terr. et fluviatiles du Portugal*, 100, lám. X, fig. única.

Anodonta macilenta Morelet, 1845. *Descript. des Moll. terr. et fluviatiles du Portugal*, 102, lám. XI, fig. única.

Anodonta lusitana Morelet, 1845. *Descript. des Moll. terr. et fluviatiles du Portugal*, 103, lám. XII, fig. 1.

Anodonta submacilenta Servain, 1880. *Étude sur les Mollusques recueillis en Espagne et en Portugal*, 162.

Anodonta martorelli Servain 1880. *Étude sur les Mollusques recueillis en Espagne et en Portugal*, 166.

Anodonta viriata Servain, 1880. *Étude sur les Mollusques recueillis en Espagne et en Portugal*, 169.

Anodonta carvalhoi Castro, 1883. *Contribut. a la faune malacologique du Portugal*, 20.
Anodonta wenceslai Castro, 1883. *Contribut. a la faune malacologique du Portugal*, 26.
Anodonta lusoiana Castro, 1883. *Contribut. a la faune malacologique du Portugal*, 31.
Anodonta calderoni Kobelt, 1887. *Anal. de la Soc. Esp. de Hist. Nat.*, t. XVI: 438.
Anodonta baetica Kobelt, 1887. *Anal. de la Soc. Esp. de Hist. Nat.*, t. XVI: 439.
Anodonta glaucina Drouet, 1893. *Unionidae de l'Espagne*, 40, lám. I, fig. 1.
Anodonta latirostris Drouet, 1893. *Unionidae de l'Espagne*, 69, lám. I, fig. 8.
Anodonta mollis Drouet, 1893. *Unionidae de l'Espagne*, 70, lám. II, fig. 7.
Anodonta adusta Drouet, 1893. *Unionidae de l'Espagne*, 75, lám. I, fig. 3.
Anodonta prasina Drouet, 1893. *Unionidae de l'Espagne*, 79, lám. II, fig. 9.
Anodonta nobilis Drouet, 1893. *Unionidae de l'Espagne*, 80, lám. II, fig. 5.
Anodonta bicolor Drouet, 1893. *Unionidae de l'Espagne*, 81, lám. I, fig. 5.
Anodonta valentina Drouet, 1893. *Unionidae de l'Espagne*, 84, lám. II, fig. 3.
Anodonta emacerata Drouet, 1893. *Unionidae de l'Espagne*, 85, lám. II, fig. 1.

Descripción original: *Mytilus anatinus* Linnaeus, 1758. *Systema Naturae*, 10. Aug.: 706, Nr. 219.
Ilustrado en: Schröter, 1779. *Die Geschichte der Flüssconchylien, etc. Halle*, lám. 1, figs. 1, 2 y 3; lám. 3, fig. 1; Rossmässler, 1837. *Iconographie der Land und Süsswasser Mollusken*, V-VI, lám. 30, figs. 416-420.

Comentario taxonómico: Un problema importante referido al tipo de *A. anatina* es que según el libro de HANLEY (1855), el ejemplar con el que Linneo describió la especie pertenece a *Anodonta complanata* (Ziegl. in Rossmässl. Iconog. Pt. iv. Pl. 20, f. 283). Efectivamente, tanto en la ilustración de HANLEY (1855, pl. 2, fig. 1) como en la de ROSSMÄSSLER (1836) se comprueba que se trata de la especie *Pseudanodonta* y no de *Anodonta*. Esto podría indicar que el nombre de *Mytilus anatinus* L. no se correspondería con *A. anatina* sino con *Pseudanodonta complanata* Rossmässler 1835. No obstante, dado que no existe la certeza de que los ejemplares que cita (e ilustra) HANLEY (1855) coincidan exactamente con los ejemplares originales de Linneo (DANCE, 1967), y para evitar mayores complicaciones, sugerimos las ilustraciones de SCHRÖTER (1779) y ROSSMÄSSLER (1837) como las representativas de *A. anatina*.

Además, la especie *A. anatina* ha sido confundida innumerables veces con *A. cygnea*, siendo ambas muy polimórficas. Aunque HAAS (1969) consideró que *A. anatina* era un sinónimo de *A. cygnea*, hoy sabemos que son especies diferentes. También es necesario avanzar que los recientes estudios utilizando marcadores moleculares indican la existencia de lo que podrían ser varias especies dentro de lo que se ha considerado *A. anatina* en la península Ibérica, y que a su vez podrían ser también diferentes de la especie que vive en el resto de Europa. Si esto fuera así, la especie (o especies) ibéricas tendrían nombres diferentes de *A. anatina*. Para evitar mayores complicaciones y en espera de obtener resultados definitivos, consideramos *A. anatina* en la península Ibérica como una sola especie igual a la presente en el resto de Europa.

Distribución: Por toda la península Ibérica (Fig. 30), en ríos, embalses y lagos. Es la especie de *Anodonta* más común.

Morfología externa (Figs. 31, 32, 33): Especie muy polimórfica, más que su congénere *A. cygnea*. Concha muy frágil, sin dientes en la charnela. Puede llegar a ser muy grande y abombada dependiendo del hábitat que ocupa. Color pardo o negro, a veces verde. Los ejemplares juveniles (Figs. 31B, C) suelen ser muy aplanados y presentar un dibujo de franjas radiales más claras. Silueta generalmente oval o cuadrangular, en ocasiones alargada pero nunca tanto como *A. cygnea*. En proporción suele ser siempre más alta que ésta. Habitualmente presenta un ala dorsal o cresta en la parte posterior más patente en los ejemplares juveniles. Ligamento más marcado y prominente que en *A. cygnea*. Borde ventral generalmente curvo. El borde dorsal puede ser curvo o recto, dibu-

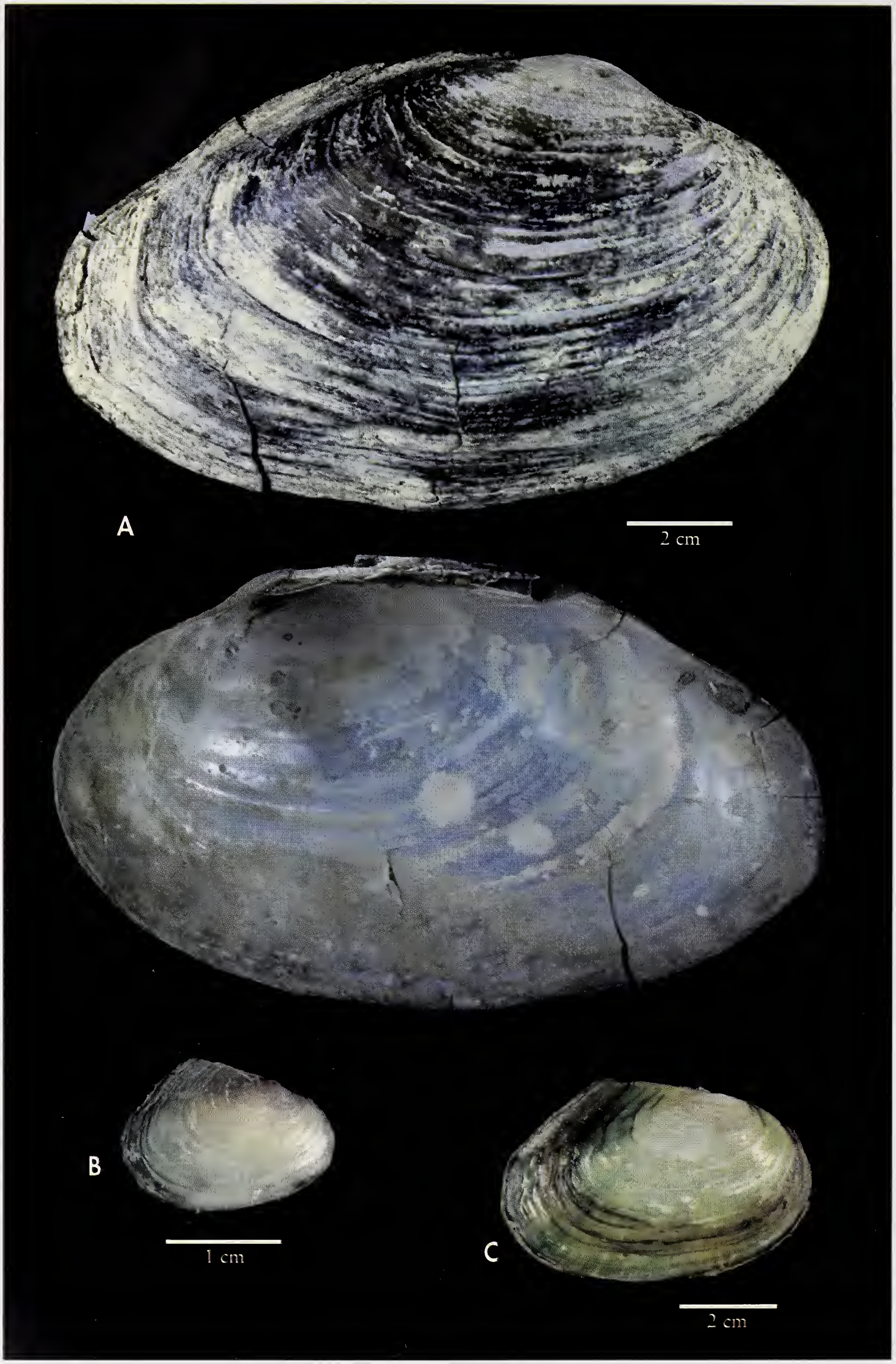

Figura 31. *Anodonta anatina*. Río Ebro. A: adulto; B, C: juveniles.
Figura 31. Anodonta anatina. *Rio Ebro. A: adulto; B, C: juvenis.*
Figure 31. Anodonta anatina. *Ebro river. A: adult; B, C: juvenile shells.*

Figura 32. *Anodonta anatina*. Embalse de Bornos (Cádiz).
Figura 32. Anodonta anatina. *Albufeira de Bornos (Cádiz).*
Figure 32. Anodonta anatina. *Bornos impoundment (Cádiz).*

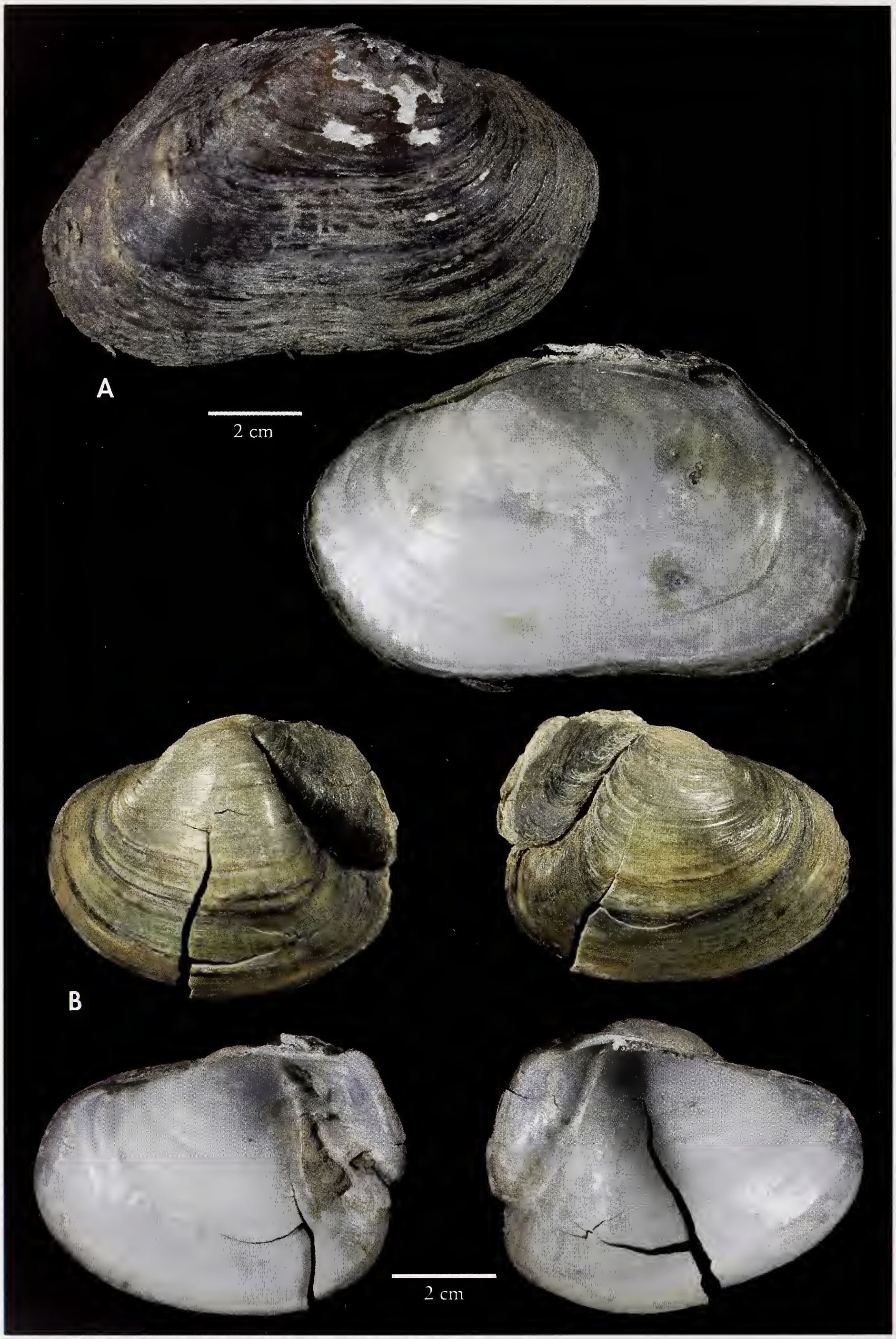

Figura 33. *Anodonta anatina*. A: río Milagro (Ciudad Real); B: ejemplar deforme del Río Ebro.
Figura 33. Anodonta anatina. *A: rio Milagro (Ciudad Real); B: exemplar deformado do Rio Ebro.*
Figure 33. Anodonta anatina. *A: Milagro river (Ciudad Real); B: deformed specimen from the Ebro river.*

jando, en este segundo caso, los lados de un triángulo: uno anterior que asciende hasta el vértice del ala y uno posterior que desciende bruscamente. Umbo plano y ancho, más saliente que en *A. cygnea*. La escultura del umbo (Fig. 13F), cuando está presente, es siempre ondulada, concéntrica y a menudo no alcanza los bordes de la concha (KENNARD *ET AL.*, 1925).

Papilas del sifón inhalante (Figs. 5I, 16F) de forma cónica y distribuidas en varias filas, prácticamente idénticas a las del género *Unio*.

Ciclo de vida: Al igual que *A. cygnea* es una especie "long-term brooder" que mantiene los gloquidios en las branquias durante todo el invierno. Solamente la branquia externa actúa como marsupio. Los gloquidios maduran en otoño y se liberan en primavera (PEKKARINEN Y ENGLUND, 1995; ALDRIDGE, 1999; PANINI, SICURO, DAPRÀ Y FORNERIS, 2009). Son de color pardo amarillento, y tanto su aspecto general (Figs. 19G, H) como su tamaño (longitud: 350-360 μm, altura: 340-360 μm) son similares a los de *A. cygnea*. La única característica útil para diferenciarlos es la superficie de la concha, que en *A. anatina* presenta un dibujo de finas costillas dorso ventrales formando un retículo (PEKKARINEN Y ENGLUND, 1995; HOGGARTH, 1999).

Aunque se trata de una especie dioica, recientemente se ha visto que pueden existir ejemplares hermafroditas (PANINI *ET AL.*, 2009).

Entre las especies hospedadoras de sus gloquidios en la península Ibérica se han señalado *Barbus graellsii* Steindachner, *Chondrostoma miegii* Steindachner, *Salaria fluviatilis* (Asso), *Gobio gobio* (L.), *Squalius pyrenaicus* (Günther) y *S. cephalus* (L.) (Gómez, obs. pers.). En otros países (PEKKARINEN Y HASTÉN, 1998) se han citado los peces *Perca fluviatilis* L., *Gymnocephalus cernuus* L., *Puntius tetrazona* (Bleeker) y la larva de la salamandra *Ambystoma tigrinum* Green.

Hábitat (Figs. 16E, F): En todo tipo de ríos, también en lagos (ej. Ruidera, Albufera de Valencia). En los embalses suele ser la única náyade presente. Habitualmente en fondos blandos de cieno y aguas remansadas, aunque también puede vivir en gravas y zonas de corriente. Es una de las náyades menos exigentes en cuanto al hábitat, probablemente por tener un amplio rango de peces hospedadores.

Conservación: Catalogada como Casi Amenazada en el Libro Rojo de los Invertebrados de España (VERDÚ Y GALANTE, 2006) y en el Libro Rojo de los Invertebrados de Andalucía (BAREA *ET AL.*, 2008).

Aunque es necesario proteger sus poblaciones, parece tener una mayor valencia ecológica que el resto de especies de náyades ibéricas.

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Presencia de *Acicula norrisi* Gittenberger y Boeters, 1977 (Gastropoda: Aciculidae) en España

Presence of *Acicula norrisi* Gittenberger and Boeters, 1977 (Gastropoda: Aciculidae) in Spain

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RESUMEN

En el presente artículo se cita por primera vez *Acicula norrisi* Gittenberger y Boeters, 1977 para España, en Andalucía, provincia de Málaga. Se describe la zona de recolección, dando datos de su geología, clima, botánica y usos. Se aportan coordenas U.T.M. y fotos de esta especie. También se citan especies acompañantes de otros micromoluscos de agua dulce y tierra de la misma zona de captura.

ABSTRACT

In this paper we record *Acicula norrisi* Gittenberger and Boeters, 1977 for the first time in the province of Málaga, Andalusia, Spain. We describe the collecting area, with data about its geology, climate, plants and uses. We also provide UTM coordinates and an illustration of this species. Some other accompanying freshwater and land micromolluscs from the area are also cited.

INTRODUCCIÓN

La familia Aciculidae Gray, 1850 está representada en España por tres géneros: *Platyla* Moquin – Tandon, 1856, *Menkia* Boeters, Gittenberger y Subai, 1985 y *Acicula* Hartmann, 1821, este último representado en el norte de España por las especie *Acicula fusca* (Montangu, 1803) y *A. callostoma* (Clessi, 1911). En la Península Ibérica se ha descrito para Gibraltar la especie *Aciula norrisi* Gittenberger y Boeters, 1977, citada nuevamente para Gibraltar por Talaván Gómez y Talaván Serna (2006). Está considerada una especie de "datos insuficientes" (DD) en el Libro Rojo de Invertebrados de Andalucía y está catalogada como vulnerable en la Lista Roja de Especies Amenazadas de la UICN (Barea-Azcón, Ballesteros-Duperón y Moreno, 2008).

En el presente trabajo se cita por primera vez para España, extendiéndose su área de distribución a Andalucía, provincia de Málaga.

El conocimiento de la biodiversidad es importante para la conservación de

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Figura 1. Vista frontal (a), dorsal (b) y lateral derecha (c) de la concha de *Acicula norrisi* (altura real 3,2 mm)
Figure 1. Front (a), dorsal (b) and right side (c) view of the shell of Acicula norrisi *(actual height 3.2 mm).*

las especies, la gestión de zonas naturales y la protección de las mismas.

Andalucía es una región con numerosos endemismos, tanto en su fauna como en su flora, por este motivo todos los datos que contribuyan al conocimiento de sus especies son importantes.

MATERIAL Y MÉTODOS

La zona del valle del Genal muestra una diversidad geológica y botánica marcada. En ella se encuentra rocas calizas karstificadas, generalmente deforestadas, sin desarrollo de suelo potente. También afloran rocas silíceas con un gran desarrollo de suelo pero con bajo o nulo porcentaje de calcio. En las peridotitas el desarrollo de suelo es escaso, al igual que la cantidad de calcio.

Las zonas de vegas son el único lugar donde las especies forestales, ligadas al suelo y a la hojarasca, pueden encontrar su hábitat. En las zonas de las vegas sí que se encuentra suelo, con humus y cubierto por hojarasca. El calcio puede provenir tanto de los aportes terrígenos de las laderas del valle como de los sedimentos aportados por las crecidas del río. La existencia de calcio en el suelo favorece la presencia de gasterópodos.

El material se ha recolectado en la localidad de Genalguacil (Málaga), U.T.M: 30 S TF94, el 09-03-2008, en la vega del río Genal, entre la hojarasca de una zona con humedad ambiental elevada.

El lugar de la recolección se encuentra en la base de un talud de una ladera de roca silícea (micaesquistos). El único aporte calizo proviene del río ya que la zona se inunda por las crecidas excepcionales. Se han medido el pH y dureza del agua del río, dando resultados de pH 8 y dureza 25º GH.

El clima es termomediterráneo (temperatura media entre 17 y 19 ºC)

Tabla I Listado de especies recolectadas en Genalguacil, vega del río Genal (Málaga) U.T.M: 30 S TF94, con indicación de su estatuto de conservación (DD = Datos insuficientes, NT = Casi amenazada) y de área de distribución general.
Table I. List of species collected at Genalguacil, in the valley of Genal river (Málaga) U.T.M: 30 S TF94, with an indication of their conservation status and general distribution range.

Familia Aciculidae Gray, 1850		
Acicula norrisi Gittenberger y Boeters, 1977 (Fig. 1)	DD	Sur Península Ibérica
Familia Ellobiidae Adams, 1855		
Carychium tridentatum (Risso, 1826)		Eurosiberiana
Familia Pristilomatidae Cockerell, 1891		
Vitrea contracta (Westerlund, 1871)		Paleártica-occidental
Familia Testacellidae Gray, 1840		
Testacella sp.		
Familia Trissexodontidae Nordsieck, 1987		
Gasuliella simplicula (Morelet, 1854)		Norte África – Sur Península Ibérica
Oestophora tarnieri (Morelet, 1854)	NT	
Oestophora ortizi De Winter y Ripken, 1991		Norte África – Sur Península Ibérica
Familia Hygromiidae Tyron, 1866		
Trichia cf. *martigena* (Férussac, 1832)	NT	Andalucía, Sur Guadalquivir
Familia Lauriidae Stemberg, 1925		
Lauria cylindracea (Da Costa, 1778)		Euromediterráneo-turánica
Familia Punctidae Morse, 1864		
Paralaoma servilis (Shuttleworth, 1852)		Mediterránea occidental-Macaronésica
Familia Valloniidae Morse, 1854		
Acanthinula aculeata (Müller, 1774)		Paleártica-occidental

Tabla II Listado de especies recolectadas en Genalguacil, vega del río Genal (Málaga), en el rezumadero. U.T.M: 30 S TF94, con indicación de su área de distribución general.
Table II. List of species collected at Genalguacil, in the valley of Genal river (Málaga), at the spring U.T.M: 30 S TF94, with an indication of their general distribution range.

Familia Sphaeriidae Dall, 1895	
Pisidium sp.	
Familia Hydrobiidae Troschel, 1857	
Potamopyrgus antipodarum (Gray, 1843)	Cosmopolita
Familia Lymnaeidae Rafinesque, 1818	
Galba truncatula (Müller, 1774)	Holártica

Tabla III. Especies adicionales encontradas en la otra orilla del río en Benarrabá, vega del río Genal (Málaga) U.T.M: 30 S TF94, con indicación de su área de distribución general.
Table III. Additional species collected at the other side of Benarrabá, in the valley of Genal river (Málaga) U.T.M: 30 S TF94, with an indication of their general distribution range.

Familia Lauriidae Stemberg, 1925	
Pupilla muscorum (Linnaeus, 1758)	Holártica
Familia Oxychilidae Hesse, 1927	
Oxychilus cf. *cellarius* (Müller, 1774)	Europa centro occidental
Familia Hygromiidae Tyron, 1866	
Microxeromagna armillata (Lowe, 1852)	Mediterráneo occidental

húmedo (precipitación media entre 1000 y 1600 mm anuales).

La vegetación de la zona pertenece fitosociológicamente a la asociación *Rubo ulmifolii-Coriarietum myrtifoliae*, que es una formación de orla de la vegetación riparia, las saucedas de *Equisto-Salicetum pedicellatae*. Se trata de una zona bastante natural aunque con cierto aprovechamiento puesto que aparece un rezumadero de agua que es utilizado como fuente. Las zonas de vegas suelen estar transformadas en huertas.

El material se ha recolectado entre la hojarasca y bajo piedras, troncos y suelo.

Todos los ejemplares fueron recolectados a mano, y se conservan conchas de todos ellos (las conchas de *Vitrea* son de otro lugar próximo). Se han reconocido todas las especies salvo una babosa no recolectada. *Oxychilus* se ha identificado por la concha, sin disección. De las conchas muertas no se han guardado las fechas, pero todas son anteriores a la de *Acicula*.

Para la identificación de las especies y su estatus se ha consultado a los siguientes autores: Kerney y Cameron (1979), Larraz y Equísoain (1993), Ruiz, Cárcaba, Porras y Arrébola (2006), Boeters, Gittenberger y Subai (1989), Gittenberger y Boeters, (1977), Talaván y Talaván (2006), López y Vaquero (2002), Rosas, Ramos y García (1992), Barea-Azcón *et al.* (2008).

RESULTADOS

En la Tabla I se presenta e listado de especies recolectadas en Genalguacil, con indicación de su estatuto de conservación y de área de distribución general.

Las especies encontradas en el rezumadero se detallan en la Tabla II.

En la vega de enfrente, en la otra orilla del río, se han recolectado también otras especies asociadas a la hojarasca de las vegas del Genal. En esta zona están presentes todas las especies acompañantes de *Acicula* salvo *Carychium* y además las incluidas en la Tabla III.

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On *Melanella stalioi* (Brusina, 1869) (Gastropoda: Eulimidae)

Sobre *Melanella stalioi* (Brusina, 1869) (Gastropoda: Eulimidae)

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ABSTRACT

We revise here the eulimid species *Melanella stalioi* (Brusina, 1869), discussing the past and recent literature by comparing the results with the type material characters. The still existing material consists of only one shell, which matches very well Brusina's original description and his repeated statement that he found only one specimen during his whole life. We have concluded that no shell of *M. stalioi* has yet been known other than the type, and that its recently published images have to be reassigned to *Vitreolina levantina* Oliverio, Buzzurro and Villa, 1994, suggesting also that the latter be moved to *Melanella* Bowdich, 1822. Lack of any further record of *M. stalioi* after the type may suggest its non European origin; although this might be likely, we think it is premature to propose removing this species from the present Mediterranean molluscan fauna.

RESUMEN

Se revisa el eulímido *Melanella stalioi* (Brusina, 1869), discutiendo la literature antigua y reciente y comparando los resultados con las características del material tipo. El material que aún se conserva consiste en una única concha, que se corresponde muy bien con la descripción original de Brusina y con su repetida afirmación de que solo encontró un único ejemplar durante toda su vida. Hemos concluido que aún no se han encontrado conchas de *M. stalioi* además de la del tipo y que las recientes imágenes publicadas deben ser reasignadas a *Vitreolina levantina* Oliverio, Buzzurro y Villa, 1994, sugiriendo además que esta última debería incluirse en el género *Melanella* Bowdich, 1822. La falta de citas adicionales de *M. stalioi* tras su descripción puede sugirir un origen no europeo; aunque podría ser el caso consideramos prematuro eliminar esta especie de la fauna mediterránea actual.

INTRODUCTION

The taxon *Eulima stalioi* Brusina, 1869, presently assigned to *Melanella* Bowdich, 1822, has been debated and interpreted several times in its 140-year existence. With the aim of better understanding the nature of this species we have examined all the bibliography available to us.

The species was described by BRUSINA (1869) on a single shell, found in Split (Dalmatia, Croatia). The author did not figure this shell either in the original paper or in the two that followed (BRUSINA, 1886, 1907) where this taxon was treated. This may have been the reason for some different points of view on *E. stalioi*; the two best known are the ones by Monterosato in CROSSE (1877) and JEFFREYS (1884), both rebutted later by BRUSINA (1886).

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The studied literature indicates that the identification of *M. stalioi* causes some difficulties even now, 140 years after its description. We have concluded that these doubts could only be dispelled by a study of Brusina's type material, provided that it still exists. Fortunately, we found the single shell of this species in the Brusina collection, hosted in HPM-Zagreb (Hrvatski Prirodoslovni Muzej, Zagreb); we were able to study it and give a report in this paper.

MATERIALS

The unique shell of *E. stalioi* present in the Brusina collection, with new inventory number 1627, was measured and photographed (Figs. 1-3). We found also the original labels, with old inventory number 1435 (Figs. 4-6), all handwritten by Brusina himself, which show the locality of origin (Split) consistent with the original description.

DISCUSSION

Brusina's original diagnosis (1869: 242-243) reads as follows:

„*E. testa turrita, obtusiuscula, solidula, nitidissima, eburnea, semipellucida; anfractibus 8 ½, contiguis, planiusculis, ultimo vix expanso, suturis distinctis; apertura magna, ovali; labro recto, obtusiuscula. – Long. 7 mill., lat. 2 ½ mill. Habitat Spalato. (Coll. Brusina, specim. 1.).*

Cette espèce se distingue, à première vue, de l'*E. intermedia*, Cantraine [*E.* (*Rissoa*) *sinuosa*, Scacchi; *E.* (*Melania*) *nitida*, Philippi, non Lamarck] par sa forme plus large, par ses tours légèrement convexes, tandis que, dans l'*E. intermedia*, ils sont tout à fait plans, et aussi bien moins nombreux (8 ½ au lieu de 13, nombre de l'unique exemplaire de l'*E. intermedia* recueilli jusqu'à présent par moi dans l'Adriatique), par la grandeur de son ouverture et par son bord externe droit et nullement dilaté. L'unique exemplaire que je connaisse jusqu'ici a été trouvé par M. le professeur Stalio de Lesina à Spalato: il a bien voulu me le donner à publier, et je ne puis mieux faire que de dédier l'espèce à celui qui l'a découverte et a enrichi ainsi d'une forme spécifique nouvelle la faune de la Dalmatie. M. G. Jeffreys, qui a eu occasion d'examiner cette espèce, a écrit sur l'etiquette: *E.* sp. n. et confirmé ainsi sa nouveauté."

Our measurements on the type were 6.7 x 2.2 mm, in good agreement with the diagnosis, but the shell is damaged, lacking its apical whorls and with a partially splintered external margin of the lip. The number of whorls matches the one in the original diagnosis, 8 ½, thus ruling out damage after the publication date. So its being *"obtusiuscula"* cannot be taken as the shell character, since it is due to the lack of apical whorls. The partial splintering of the external lip is indeed minor damage since the lip profile can be easily seen in the scars present on the whorls: they are almost straight, with only a hint of median bulge and no clear adapical sinus. The shell shape is straight, a character not mentioned by Brusina, and the whorls are distinctly convex. All these characteristics clearly distinguish *M. stalioi* from all other European *Melanella*.

MONTEROSATO (1872) reports for the first time on *E. stalioi*, quoting it "ex typ." and stating „è stata recentemente riferita alla *E. glabella*, S. Wood, del Crag", but without referring to the origin of this opinion; he adds, "l'esemplare ..... non e sufficientemente ben conservato". It is clear that he saw the type material during the visit to Brusina in Zagreb in 1872, and possibly some Crag material during his journey to England shortly before. This dubious synonymy with *Eulima glabella* S. Wood, 1842 was repeated (MONTEROSATO, 1875, 1878), but Monterosato's opinion was never a final one. He, for instance, wrote as well "*Eul. stalioi* (? *polita*) forma estraordinaria" in a handwritten list of notes on Brusina collection (PALAZZI AND RYOLO, 2008) in an envelope which had the writing "Zagreb 17 July 1872. Brusina Coll." (Giannuzzi-Savelli, private comm.).

Figures 1-6. *Melanella stalioi.* 1-3: front, side and dorsal views of the holotype (HPM, Zagreb, new inv. n° 1627), 6.7 x 2.2 mm; 4-6: Brusina's handwritten labels.
Figuras 1-6. Melanella stalioi. *1-3: vista frontal, lateral y dorsal del holotipo (HPM, Zagreb, nuevo inv. n° 1627), 6,7 x 2,2 mm; 4-6: las etiquetas manuscritas de Brusina.*

CROSSE (1877) published the drawing of a shell he received from Monterosato "comprise dans un envoi en communication": we shall refer to this taxon as *E. stalioi* sensu Monterosato in Crosse, 1877, the assignment being from the latter author. That confirms Monterosato's doubts on the nature of *E. stalioi*; as a matter of fact his most important catalogue of Mediterranean molluscs (MONTEROSATO, 1884) does not mention at all this species.

Although Jeffreys also saw Brusina's shell during his visit to Zadar in 1867 shortly before the paper on *E. stalioi*, he had presented in 1884 quite a different shell for Brusina's *stalioi*. His drawings show a shell slightly but evidently curved (*stalioi* is straight) and having flat whorls (distinctly convex in *stalioi*).

BRUSINA (1886) wrote again on *E. stalioi*, having seen the misinterpretations of his species by Monterosato in CROSSE (1877) and JEFFREYS (1884).

He first explains he wrote to Jeffreys on this matter and that Jeffreys asked for his specimen for inspection. Here, for the second time, Brusina states the uniqueness of his shell: "Mi pregò di mandargli il mio esemplare in communicazione e sebbene a malincuore feci fare il viaggio del nostro esemplare unico ed originale fino a Londra, pure l'ho fatto nell'interesse della scienza." After Jeffreys acknowledged his misinterpretation, Brusina suggested a new name for Jeffreys' species, naming it *Eulima doderleini*.

BOUCHET AND WAREN (1986) recently transferred the latter to *Melanella*, choosing Jeffreys' specimen as a lectotype of *Melanella doderleini* (Brusina, 1886). They support its difference from *E. stalioi* since „We have examined material of *E. stalioi* determined by Brusina in ZMR [Zoological Musem Rome] (sent to Monterosato) and we can verify Brusina's statement."

We did not examine this material in Rome and can not even know what it really is since Brusina had only one shell of *E. stalioi* according to all the published data. This doubt about the material in ZMR even increased after we had received the information from Dr. Warén that the specimen he saw in Rome and the type of *stalioi* did not belong to the same species.

In the same paper BRUSINA (1886) also denied that Monterosato's (in Crosse) *E. stalioi* could resemble his species: „ ... perchè la nostra specie è notevolmente più stretta ed i giri sono visibilmente più convessi, mentre nella specie del Crosse si mostrano del tutto piani." Brusina then proposes a new name for this shell also, i.e. *Eulima crossei*. Later on MONTEROSATO (1890) himself quotes *Eulima crosseana* Brusina, 1886 as a new name for the *E. stalioi* published by Crosse; the right name however should be *crossei*, while we regard *crosseana* as an unjustified emendation.

Shortly before his death, in a book on his travels, BRUSINA (1907: 43-228) wrote on *stalioi* for the last time, stating again that he had seen only one specimen in his whole life:

„Prvi i jedini primjerak dobio sam na dar od prof. Stalia, koji je tvrdio, da ga je našao kod Spljeta; čuva se u narod. Muzeju; ali moram reći, da mi je malko sumnjiv ne samo zato, što je još uvijek unikum, nego još više zato, što je neobična oblika."

[The first and only specimen I received as a gift from professor Stalio, who affirmed that he found it near Split; it is kept in the National Museum; however, I must say that it is a bit suspicious to me, not only because it is still unique, but even more so because of its unusual shape.]

TENEKIDES (1989) and GIANNUZZI-SAVELLI, PUSATERI PALMERI AND EBREO (1999) figured three shells assigned to *stalioi*, from Greek (2) or Turkish waters (1). These shells are quite different from the *E. stalioi* type and we think that all specimens have to be assigned to *Vitreolina levantina* Oliverio, Buzzurro and Villa, 1994. We carefully compared the shell shape from these images with those of the holotype of *V. levantina* and found no relevant difference either in the shape or in the opening conformation and apex structure. The same goes for our specimens (Figs. 7-9). We finally

Figures 7-9. Shells of *Melanella levantina*. 7, 8: front and side views, h = 6.2 mm, Bozcaada Island, Turkey, 8 m; 9: side view, h = 4.9 mm, Turkey 15 m.
Figuras 7-9. Conchas de Melanella levantina. *7, 8: vistas frontal y lateral, h = 6,2 mm, Isla de Bozcaada, Turquía, 8 m; 9: vista lateral, h = 4,9 mm, Turquía 15 m.*

examined why the authors put this species in *Vitreolina*, a genus normally hosting quite different looking forms (i.e. vitreous, much more slender, less sturdy set). Their main reasons were the curved shell, the general opening appearance and the dip present at the lip scar – suture crossing. We point out that a curved shell is present in some *Melanella* as well, and moreover the photograph in their paper showing the false suture dip at the scar crossing is unclear. We gained the opinion that *Melanella* should be a more suitable genus for this species, even if provisionally, due to its morphological characters: the shell height is unusual, more than 7 mm, it is not glossy transparent and its "false suture" has a poor or null dip while crossing the lip scar. We therefore suggest naming this species *Melanella levantina* (OLIVERIO, BUZZURRO AND VILLA, 1994).

CONCLUDING REMARKS

The main result of this paper is twofold: we at last know, 140 years since its description, the true aspect of *Eulima stalioi* and this can rule out many incorrect interpretations of this species, while

on the other hand we are left with a new problem, since we have seen no other material of this species. Moreover, we do not know any *Melanella* record in literature which could possibly be related to the *stalioi* type, at least among the European species. The appearance of the *stalioi* photos may make it possible for someone to assign his material to such species, but we doubt it due to lots of material we examined from our personal and other collections.

We carefully examined the shell of *stalioi* searching also for a sign of an abnormal shell growth, but we found none apart from the labial scars.

Dr. A. Warén (*in litteris*) suggested a non-European origin for the *stalioi* type, relating it to a group of non-European *Melanella* species, such as: *Melanella randolphi* (Vanatta, 1899), from Unalaska, Alaska; *Melanella lowei* (Vanatta, 1899) (see Vanatta, 1899), from Long Beach, California; the Caribbean *Melanella nutans* (Mühlfeld, 1824) (Redfern, 2001); and some unnamed Indo-Pacific species, mostly because of some similarities in the convexity of the whorls. We examined the above mentioned species and some others in Bartsch (1917), yet we found none resembling the *stalioi* type enough to be regarded as conspecific. Our knowledge of this group of species is however too poor to be conclusive on this point, and we leave to future studies a deeper insight into this matter.

We think that we truly found the original shell of Brusina's *stalioi* and that the specimen was found in Split by Stalio. This conclusion is supported also by the fact that Brusina and Stalio were interested in studies of marine fauna only and exclusively in the Adriatic Sea; both authors wrote many articles on this matter. Here we need to mention that all the eulimid material in Brusina's collection is from the Adriatic Sea.

Finally we think that it is too early to propose removing *Melanella stalioi* from the present Mediterranean molluscan fauna, considering only its suspected non-European origin and the lack of any record after the type.

AKNOWLEDGMENTS

We wish to thank Dr. Vesna Štamol (HPM, Zagreb) for providing us with the material from the Brusina collection. We would like to thank Dr. A. Warén (Stockholm) for his priceless comments on the holotype, and aknowledge his critical reading of our paper. Last but not least we thank R. Giannuzzi-Savelli (Palermo) for his information about Monterosato's unpublished papers, Harry G. Lee (Jacksonville, Florida) for providing us with the scans of the Redfern book tables on *Vitreobalcis nutans*, Mr. S. Bartolini (Florence) for some photographs, and Mrs. D. Šantić for her valuable revision of English.

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Two new *Fusinus* (Gastropoda: Fasciolariidae) from the Canary Islands

Dos nuevos *Fusinus* (Gastropoda: Fasciolariidae) de las Islas Canarias

Roland HADORN* and Emilio ROLÁN**

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ABSTRACT

Two new *Fusinus* Rafinesque, 1815, are described from the Canary Islands: the sinistral *F. saundersi* sp. nov. from Lanzarote, 3-15 m deep, is compared to *F. maroccensis* (Gmelin, 1791) and *F. elegans* (Reeve, 1848), both from the West African coast; the dextral *F. hernandezi* sp. nov. from northwest Gran Canaria, 150-200 m deep, is compared to *F. tenerifensis* Hadorn and Rolán, 1999 and *F. sectus* (Locard, 1897).

RESUMEN

Se describen dos nuevos *Fusinus* Rafinesque, 1815 de Canarias: el levógiro *F. saundersi* sp. nov. de Lanzarote se compara con *F. maroccensis* (Gmelin, 1791) y con *F. elegans* (Reeve, 1848), ambos de la costa oeste africana; el dextrógiro *F. hernandezi* sp. nov. del noroeste de Gran Canaria se compara con *F. tenerifensis* Hadorn y Rolán, 1999 y con *F. sectus* (Locard, 1897).

INTRODUCTION

The genus *Fusinus* is well represented in the Mediterranean fauna by a number of small to medium sized species. SABELLI, GIANNUZZI-SAVELLI and BEDULLI (1990) have mentioned 5 species (and some more synonyms) from the Mediterranean. Since that moment, new studies were realized on additional material and more species were described: BUZZURRO and RUSSO (2007) already mentioned 11 Mediterranean species and described 4 more. The presence of a paucispiral protoconch is evidence for a short dispersion range and a possible indication for endemism. This is the reason for which even after the work of BUZZURRO and RUSSO (2007), one more species has been described (HADORN, AFONSO and ROLÁN, 2009). HADORN AND ROLÁN (1999) described *F. tenerifensis* from the Canary Islands and HADORN and RYALL (1999) described *F. boucheti* from the Ibero-Moroccan Gulf and the Canary Islands from deep water.

Some species from the Canary Islands are usually recorded as being the same taxa as in the Mediterranean: *Fusinus pulchellus* (Philippi, 1844), *F. rostratus* (Olivi, 1792) and *F. syracusanus* (Linnaeus, 1758). *Fusinus bocagei* (P. Fischer, 1882) from deep water is the only species known to us that lives both in the Canary Islands and in Europe and West African coasts.

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The Canary Islands are an archipelago with a high number of endemics. In the last months, owing to the preparation of a book on Canary Islands molluscs, some of the populations collected from this archipelago and stored in the collections of José María Hernández, Francisco Déniz and the second author were studied. The present paper is the result of this study.

Abbreviations

MNCN: Museo Nacional de Ciencias Naturales de Madrid, Spain
MNHN: Muséum national d'Histoire naturelle, Paris, France
MHNS: Museo de Historia Natural, Santiago de Compostela, Spain (Coll. Emilio Rolán)
CFD: Collection of Francisco Déniz, Las Palmas, Gran Canaria, Canary Islands, Spain
CJH: Collection of José María Hernández, Gáldar, Gran Canaria, Canary Islands, Spain
CKF: Collection of Koen Fraussen, Aarschot, Belgium
CRH: Collection of Roland Hadorn, Röthenbach, Switzerland
dd: dead collected specimen
juv: juvenile specimen
lv: live collected specimen

SYSTEMATICS

Family Fasciolariidae Gray, 1853
Genus *Fusinus* Rafinesque, 1815

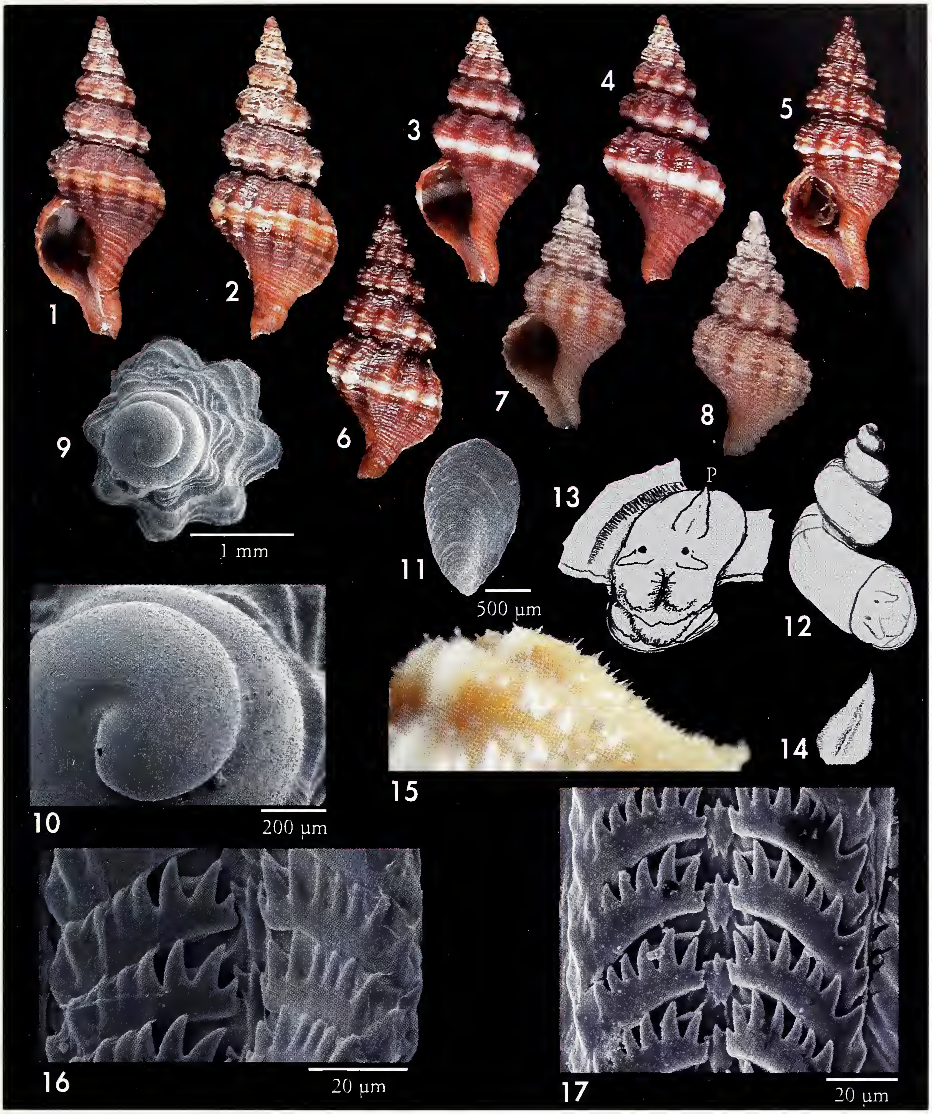
Fusinus Rafinesque, 1815: 145. Substitute name for '*Fusus* Lamarck 1799' [=*Fusus* Bruguière, 1789], non *Fusus* Helbling, 1779.
Type species: *Murex colus* Linnaeus, 1758, by typification of replaced name.

Sinistral species of *Fusinus* are usually placed in the genus *Sinistralia* H. and A. Adams, 1853 (type species by subsequent designation: *Murex maroccensis* Gmelin, 1791 [Recent, west Africa]). Bouchet and Warén (1985: 160) placed *Sinistralia* in synonymy with *Fusinus*. Records of *F. maroccensis* (Gmelin, 1791) and *F. elegans* (Reeve, 1848) from the Canary Islands are probably erroneously based on misidentification of the new species. Other known sinistral *Fusinus* are restricted to the Indian Ocean: *F. barclayi* (G.B. Sowerby, III, 1894) from Maurititus, *F. gallagheri* Smythe and Chatfield, 1981 from Oman and *F. somaliensis* Smythe and Chatfield, 1984 from Somalia. *F. depictus* (G.B. Sowerby, II, 1880) is a doubtful species which was described without locality. According to Smythe and Chatfield, 1984 (p. 309) it is perhaps not a marine species. Anyway, *F. depictus* differs from *F. saundersi* sp. nov. by the obviously smooth surface with a distinct colouration, the conspicuously short spire and the ventricose body whorl.

Fusinus saundersi sp. nov. (Figs. 1-16)

1978. Saunders, G.D.: 18-19 (as sinistral *Fusinus* from Lanzarote).
1982. Nordsieck, F.: 230, pl. 79, fig. 82.50 (as *Sinistralia maroccensis*).
1999. Hadorn, R. and E. Rolán, 1999: 44-45, fig. 21 (showing radula of *F. saundersi* as *F. (Sinistralia) maroccensis*).
2004. Ardovini, R. and T. Cossignani: 174 (as *Sinistralia maroccensis*).

Type material: Holotype (Figs. 1-2) (MNCN 15.05/51.016) (19.6 x 8.1 mm, lv). – Paratype 1 (Figs. 3-4) (MHNS) (16.7 x 7.8 mm, lv). – Paratype 2 (MHNS) (16.6 x 7.6, lv) – Paratype 3 (Figs. 5-6) CRH (17.0 x 7.4 mm, lv). – Paratype 4 CRH (14.7 x 6.2 mm, lv). – Paratype 5 CJH (14.8 x 6.3 mm, lv). – Paratype 6 CKF (19.0 x 8.1 mm, dd). Paratypes 1-5 from type locality, paratype 6 from the Canary Islands, northwest Gran Canaria, Sardina, 3 m deep.



Figures 1-13. *Fusinus saundersi* sp. nov. 1, 2: holotype (MNCN 15.05/51.016), Canary Islands, Lanzarote, Punta Quemada, 3-15 m deep, 19.6 mm; 3, 4: paratype 1 (MHNS), Canary Islands, Lanzarote, Punta Quemada, 3-15 m deep, 16.7 mm; 5, 6: paratype 3 (CRH), Canary Islands, Lanzarote, Punta Quemada, 3-15 m deep, 17.0 mm; 7, 8: shell (CRH), colour form, Canary Islands, northwest Gran Canaria, Sardina, 15.3 mm; 9: protoconch; 10: microsculpture of the protoconch; 11: operculum, shell size 5.0 mm; 12: animal, drawing, shell size 13.5 mm; 13: detail of the soft parts (P= penis); 14: penis; 15: periostracum from a paratype; 16: radula, shell size 5.0 mm; 17: Radula, shell size 13.5 mm.

Figuras 1-13. Fusinus saundersi *sp. nov.. 1, 2: holotipo (MNCN, 15.05/51.016), Islas Canarias, Lanzarote, Punta Quemada, 3-15 m de profundidad 19,6 mm; 3, 4: paratipo 1 (MHNS), Islas Canarias, Lanzarote, Punta Quemada, 3-15 m de profundidad, 16,7 mm; 5, 6: paratipo 3 (CRH), Islas Canarias, Lanzarote, Punta Quemada, 3-15 m de profundidad, 17,0 mm; 7, 8: shell (CRH), forma de color, Islas Canarias, northwest Gran Canaria, Sardina, 15,3 mm; 9: protoconcha; 10: microescultura de la protoconcha; 11: operculo, concha de 5,0 mm; 12: dibujo del animal, concha de 13,5 mm; 13: detalle de las partes blandas (P= pene); 14: pene; 15: periostraco de un paratipo; 16: rádula, concha de 5,0 mm; 17: rádula, concha de 13,5 mm.*

Additional material: Canary Islands, Rolán Collection 15657 (MHNS), 2 lv, 1 dd juv. – Canary Islands, Gran Canaria, Las Palmas, Rolán Collection 16128 (MHNS), 1 dd. – Canary Islands, northwest Gran Canaria, Sardina, 15 m deep, CJH, 3 lv, 2 lv juv; CRH, 2 lv [in alcohol]. – Canary Islands, northwest Gran Canaria, Sardina, 15 m deep, CJH, 17 dd juv.
Type locality: Punta Quemada, Lanzarote, Canary Islands, 3-15 m deep.
Etymology: Named after G.D. Saunders, the first author who recorded shells of this species.

Description: Shell (Figs. 1-8) small (up to 25 mm), fusiform, sinistral, consisting of about 8 convex whorls (including protoconch) with a slight subsutural concavity. Light brown to dark brown, with a distinct white band at periphery. Usually lighter coloured on axial ribs, darker in the interspaces. A uniformly light brown colour form exists with darker brown interspaces between axial ribs. Spire angle broad (about 35-40°). Suture incised, wavy according to the axial ribs of preceding whorl.

Protoconch (Fig. 9) dark brown, glossy, consisting of 1 ½ to 1 ¾ whorls. Last part (¼ whorl) ornamented with 4-5 strong axial riblets, reaching from suture to suture, separated by broad, deep interspaces. Microsculpture (Fig. 10) of very small granules only in the non eroded material. Diameter 0.8-1.0 mm.

Axial sculpture consisting of broad, oblique axial ribs, traversing from below the subsutural concavity to the lower suture; most prominent at periphery, separated by narrow deep interspaces. 7 or 8 axial ribs on upper postnuclear whorls, 9 on antepenultimate, 10 or 11 on penultimate and 11-13 on body whorl. Fine axial growth lines are well visible.

Spiral sculpture consisting of broad, strong, rounded spiral cords, more prominent when crossing the axial ribs, weaker in the interspaces. Teleoconch beginning with 3 strong, light brown to white coloured primary spiral cords; the abapical cord strongest, the 2 abapical cords usually lighter coloured. From the second whorl onwards an additional fine spiral cord appears below the 3 central cords, soon becoming as strong as the subsutural cord. A fine secondary spiral cord intercalated between the primary cords on the penultimate and body whorls. Some indistinct fine spiral cords of different strength visible in the subsutural area.

Aperture ovate, pinched at both ends, brown coloured, the white band well-visible inside the aperture. Outer lip thin, edge slightly crenulated, with numerous fine internal lirae. Parietal callus thin, almost obsolete, smooth. Columella smooth. Siphonal canal short, slightly curved to the right and slightly bending backwards, widely open. Aperture and siphonal canal together about $^{2}/_{5}$ of total shell length.

Periostracum (Fig. 15) fine, light brown, hairy.

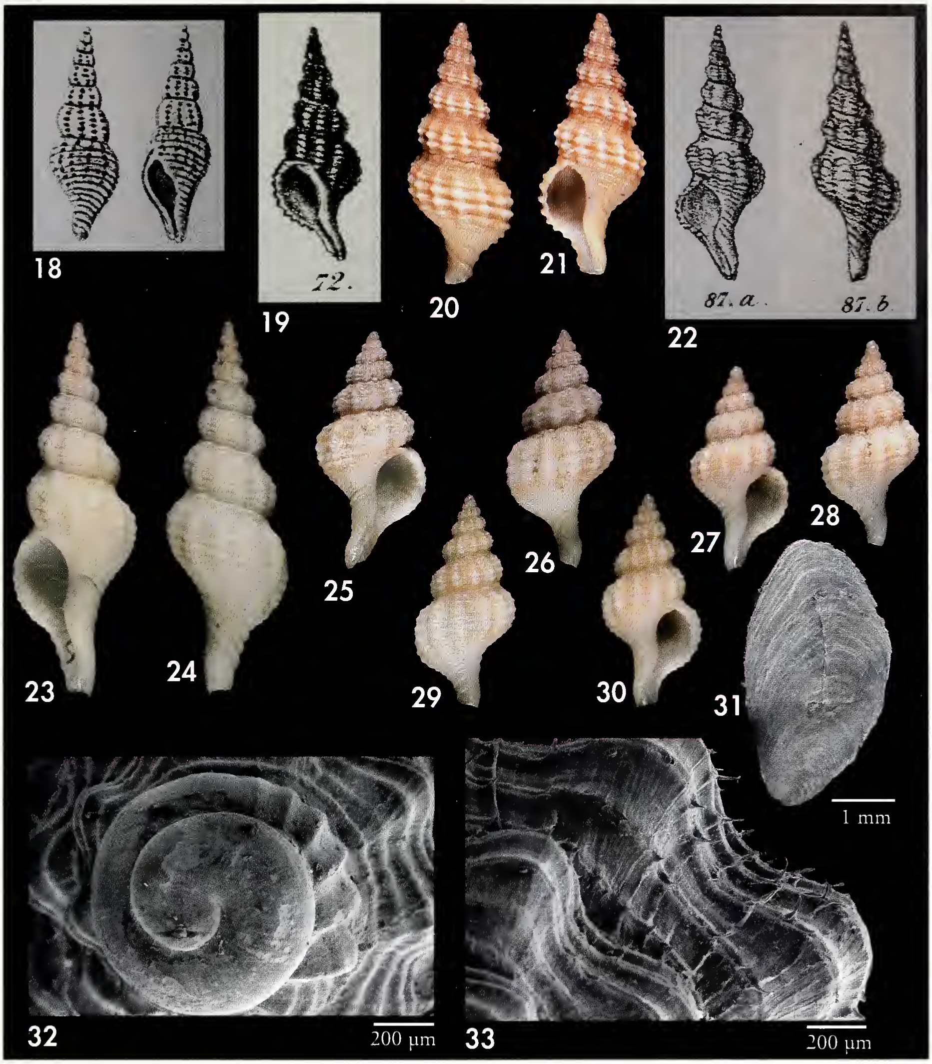
Operculum (Fig. 11) corneous, light brown, thin, ovate, filling aperture, adapically rounded, abapically with terminal nucleus, ornamented with fine concentric growth lines.

Radula (Figs. 16, 17) fasciolariid, typical for genus. Central tooth tricuspid, elongate, with broad convex base and narrow rounded tip. Lateral teeth strongly curved, broad, with 8-10 strong, broad, rather short cusps with incurved tips. At inner end with a small denticle.

Animal (Figs. 12, 13) red with small white spots, a large ctenidium with very numerous lamellae, placed at right side. The penis (Fig. 14) is placed behind the left eye and is lanceolate, leaf shaped, and relatively short.

Range and habitat: Canary Islands, reported from Gran Canaria, Tenerife and Lanzarote, live collected specimens 3-15 m deep.

Comparison: F. elegans (Reeve, 1848) was erroneously placed in synonymy with *Fusus maroccensis* (Gmelin, 1791) by Tryon, 1881 (p. 66). *F. elegans* (Figs. 22-24) differs from *F. maroccensis* (Figs. 18-21) by the white or cream coloured shell, the white protoconch, the weaker and less conspicuous but somewhat broader



Figures 18-21. *Fusinus maroccensis* (Gmelin, 1791). 18: original figures in CHEMNITZ, 1788, pl. 105, figs. 896; 19: original figure in REEVE, 1848, pl. 19, fig. 72; 20, 21: West Morocco, off Agadir, 17.9 mm (CRH). Figures 22-24. *Fusinus elegans* (Reeve, 1848). 22: original figures in REEVE, 1848, pl. 21, figs. 87a-b; 23, 24: Western Sahara, Cape Barba, 32 m deep, 26.9 mm (CJH). Figures 25-33. *Fusinus hernandezi* sp. nov., Canary Islands, northwest Gran Canaria, 28° 06' 46" N, 15° 48' 85" W, 150-200 m deep. 25, 26: holotype (MNCN 15.05/51.017), 16.4 mm; 27, 28: paratype 1 (MHNS), 14.0 mm; 29, 30: paratype 3 (CRH), 14.6 mm; 31: operculum; 32: protoconch; 33: detail of the periostracum.

Figuras 18-21. Fusinus maroccensis *(Gmelin, 1791). 18: figuras originales en CHEMNITZ, 1788, lám. 105, figs. 896; 19: figuras originales en REEVE, 1848, lám. 19, fig. 72; 20, 21: Marruecos oeste, frente a Agadir, 17,9 mm (CRH). Figuras 22-24.* Fusinus elegans *(Reeve, 1848). 22: figuras originales en REEVE, 1848, lám. 21, figs. 87a-b; 23, 24: Sahara Occidental, Cabo Barba, 32 m de profundidad, 26,9 mm (CJH). Figuras 25-33.* Fusinus hernandezi *sp. nov., Islas Canarias, noroeste de Gran Canaria, 28° 06' 46" N, 15° 48' 85" W, 150-200 m de profundidad. 25, 26: holotipo (MNCN 15.05/51.017), 16,4 mm; 27, 28: paratipo 1 (MHNS), 14,0 mm; 29, 30: paratipo 3 (CRH), 14,6 mm; 31: opérculo; 32: protoconcha; 33: detalle del periostracum.*

axial ribs and the finer, less conspicuous and more numerous spiral cords. The smooth subsutural concavity in *F. elegans* is only well visible in large adult specimens.

F. elegans (Figs. 22-24) from the Western Sahara differs from *F. saundersi* sp. nov. by the white to cream coloured shell, the white protoconch, the longer, more delicate and more slender spire, the whorls excavated below the suture (only in adult specimens), the weaker and less distinct white axial ribs, the more close-set spiral cords and the shallower interspaces between them.

F. maroccensis (Figs. 18-21) from West Morocco differs from *F. saundersi* sp. nov. by the light brown to cream coloured shell, the light brown protoconch, the longer, more delicate and more slender spire, the more incised suture, the more convex whorls, the weaker, narrower and slightly oblique white axial ribs, the more prominent spiral cords and the deeper grooves between them.

Fusinus hernandezi sp. nov. (Figs. 25-33)

Type material: Holotype (Figs. 25-26) (MNCN 15.05/51.017) (16.4 x 7.7 mm, lv). – Paratype 1 (Figs. 27-28) (MHNS) (14.0 x 6.7 mm, lv). – Paratype 2 (CJH) (12.7 x 6.4 mm, lv). – Paratype 3 (Figs. 29-30) (CRH) (14.6 x 6.9 mm, lv).
Additional material: 2 juvenile specimens (6.4 mm / 5.7 mm) from type locality (CJH). 1 shell (14.5 mm) from Canary Islands, northwest Gran Canaria, 28° 02′ 049″ N, 15° 52′ 580″ W, 250 m deep (CFD).
Type locality: Northwest Gran Canaria, Canary Islands, 28° 06′ 46″ N, 15° 48′ 85″ W, 150-200 m deep.
Etymology: Named after José María Hernández who collected the studied material.

Description: Shell (Figs. 25-30) small (up to 17 mm), white with inconspicuously brownish tinged interspaces between axial ribs, fusiform, spire elongate but rather broad, consisting of about 7 convex whorls including protoconch. Suture constricted, incised, wavy according to the axial sculpture of preceding whorl.

Protoconch (Fig. 32) white to cream, bulbous, smooth, glossy, consisting of 1 ½ whorls, last part (¼ whorl) ornamented with 4-6 axial riblets reaching from suture to suture, becoming stronger and broader towards the end of protoconch. Diameter 0.8-1.0 mm.

Axial sculpture consisting of about 9 or 10 strong, broad axial ribs per whorl, 11 or 12 on body whorl, reaching from just below the upper suture to the lower suture, separated by rather deep narrow interspaces.

Spiral sculpture consisting of 5 rather fine, rounded, primary spiral cords, separated by broad interspaces and by 2 fine subsutural inconspicuous cords. An intercalated fine secondary spiral cord appears from the fourth postnuclear whorl onwards.

Aperture round-ovate, white, with about 10 or 11 strong internal lirae. Outer lip crenulated. Parietal callus adherent, thin, inconspicuous, smooth, underlying spiral sculpture of the body whorl well visible through the callus. Columellar folds absent.

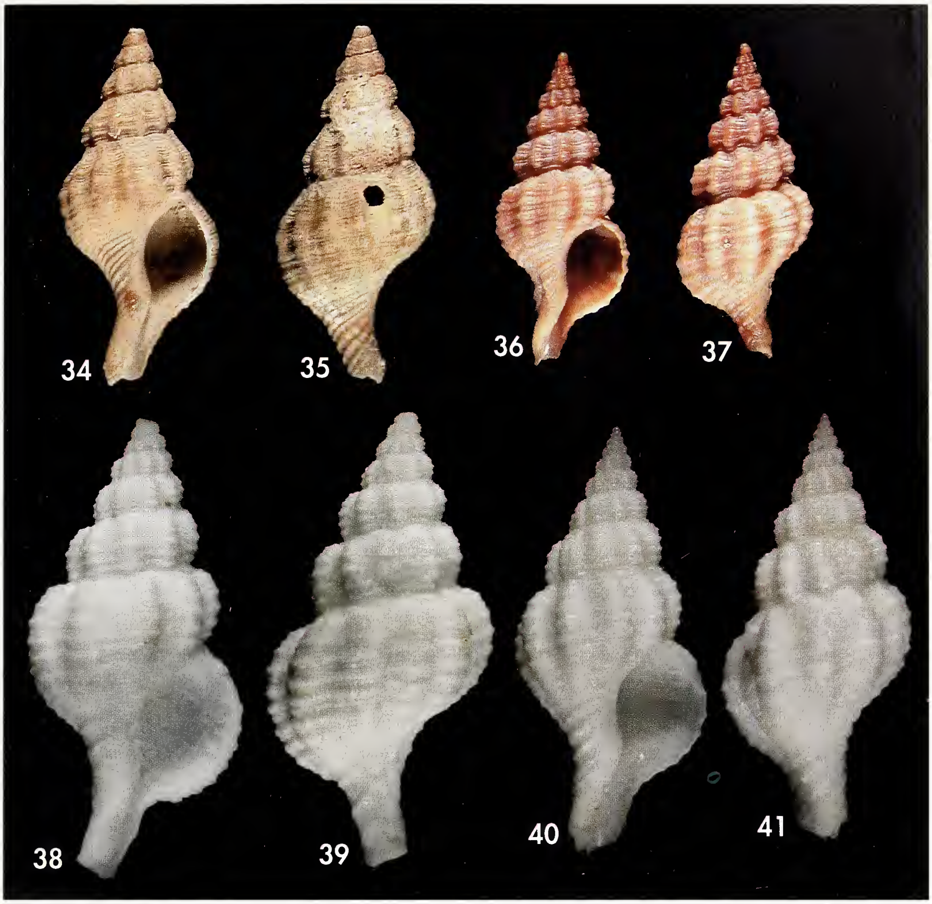
Siphonal canal about as long as aperture length, open, slightly curved to the left and backwards. Outer side ornamented alternating strong primary and fine secondary spiral cords. Aperture and siphonal canal together about ½ of total shell length.

Periostracum (Fig. 33) thin, transparent, light brown, slightly hairy.

Operculum (Fig. 31) corneous, thin, light brown, with terminal nucleus, filling aperture.

Animal and radula were not studied due to the scarcity of the material available.

Range and habitat: Known only from northwest Gran Canaria, Canary Islands, 150-250 m deep.



Figures 34, 35. *Fusinus sectus* (Locard, 1897), Holotype (MNHN), off Mauritania, 24.5 mm. Figures 36, 37. *Fusinus tenerifensis* Hadorn and Rolán, 1999, Canary Islands, La Palma, Santa Cruz de La Palma (CRH), 21.5 mm. Figures 38-41. *Fusinus* species, Canary Islands, northwest Gran Canaria. 38, 39: 180 m deep, 39.3 mm (CJH); 40, 41: 280 m deep, 36.9 mm (CFD).
Figuras 34, 35. Fusinus sectus *(Locard, 1897), Holotipo (MNHN), frente a Mauritania, 24,5 mm. Figuras 36, 37.* Fusinus tenerifensis *Hadorn and Rolán, 1999, Islas Canarias, La Palma, Santa Cruz de La Palma (CRH), 21,5 mm. Figuras 38-41.* Fusinus *species, Islas Canarias, noroeste de Gran Canaria. 38, 39: 180 m de profundidad, 39,3 mm (CJH); 40, 41: 280 m de profundidad, 36,9 mm (CFD).*

Comparison: 2 large, dead, entirely white specimens (Figs. 38-41) were collected near the type locality (28° 07′ N, 15° 50′ W, 180 m deep, 39.3 x 19.1 mm, CJH / 28° 03′ 280″ N, 15° 53′ 708″ W, 280 m deep, 36.9 x 16.9 mm, CFD). Both shells resemble superficially *F. hernandezi* sp. nov., but differ by the much larger size, the smaller number (about 8-10 per whorl) of stronger and broader axial ribs and the wider interspaces between them. Until more material is collected, we prefer to leave this distinct species undescribed.

F. sectus (Locard, 1897) (Figs. 34-35) differs from *F. hernandezi* sp. nov. in the less constricted suture, the less convex whorls, the smaller number of strong primary spiral cords with broader interspaces between them, the conspicuously large number of fine secondary spiral cords mainly on the shoulder but

also between the primary spiral cords, and the less conspicuous axial ribs.

F. tenerifensis Hadorn and Rolán, 1999 (Figs. 36-37) differs from *F. hernandezi* sp. nov. by the larger size, the more elongate spire, the brown coloured shell with brown protoconch, the more pronounced axial sculpture, the deeper interspaces between the axial ribs, the smaller number of axial ribs, and the stronger primary spiral cords with strong intercalated secondary cords.

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Two new species of *Putzeysia* (Prosobranchia, Chilodontidae) from the Canary Islands

Dos nuevas especies de *Putzeysia* (Prosobranchia, Chilodontidae) de las islas Canarias

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Recibido el 23-III-2009. Aceptado el 1-X-2009

ABSTRACT

Two new species of the genus *Putzeysia* are described, showing the shell characters, including protoconch and microsculpture; the new species are compared with the only known Mediterranean species for the genus, *P. wiseri*.

RESUMEN

Se describen dos nuevas especies del género *Putzeysia*, presentándose las características de la concha, incluida la protoconcha y la microescultura; las nuevas especies se comparan con la única de este género que se conoce en el mar Mediterráneo, *P. wiseri*.

INTRODUCTION

In Europe, only one species of the genus *Putzeysia* Sulliotti, 1889 was known hitherto: *Putzeysia wiseri* (Calcara, 1842), which is well illustrated in GIANNUZZI-SAVELLI, PUSATERI, PALMERI AND EBREO (1994, fig. 263) and ARDOVINI AND COSSIGNANI (1999: 34).

In the material collected in several dredgings in the Canary Islands, numerous shells of a minute species group were found. In ENGL (1994) these specimens were identified as *P. wiseri* in spite of differences in the height/width range. After a more detailed comparison (mainly through scanning electron microscopy) of this material with the Mediterranean species, two closely similar but different species are described as new in the present work.

Abbreviations

MHNS Museo de Historia Natural, Santiago de Compostela
MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Museum National d'Histoire Naturelle, Paris
MNHC Museo de la Naturaleza y el Hombre, Santa Cruz de Tenerife
SMNH Seckenberg Museum Natural History,
ZMH Zoologisches Museum, Hamburg
ZMB Zoologisches Museum, Berlin
ZSM Zoologische Staatssammlung, München,
CWE Collection of Winfried Engl

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SYSTEMATICS

Superfamily Seguenzioidea Verrill, 1884
Family Chilodontidae Wenz, 1938
Subfamily Chilodontinae

Genus *Putzeysia* Sulliotti, 1889

Type species: *Trochus clathratus* Aradas, 1847 [= *Trochus wiseri* Calcara 1842].

Putzeysia franziskae spec. nov. (Figs. 3, 7, 8, 11-13)

Type material: Holotype (ZSM 20090099)(Figs. 3, 7) and five paratypes (ZSM 20090100). Other paratypes in the following collections: MHNS (1), MNCN (1), MNHC (1), MNHN (1), SMNH (2), ZMH (2), ZMB (2), CWE (100) (all ex CWE, collected from 1975 to 2000).
Type locality: Puerto del Carmen, Lanzarote, Canary Islands, 30-50 m.
Etymology: This species is named after Franziska, the mother of the first author.

Description: Shell (Figs. 3) turbinoid, globose, with 4-4 ¾ spiral whorls of a rather quick development, last one rounded, representing more that 60 % of the total height. Protoconch (Fig. 7) with less than one whorl, a diameter of 290 μm and a nucleus of about 110 μm. Under strong magnification (Fig. 8) a microsculpture consisting of irregular shapes is observed, as well as 2 fine oblique threads. Teleoconch whorls with axial ribs: 12 on the first whorl, 14-16 on the second, about 30 on the last whorl, which are strongly prosocline, and narrower than the interspaces. The spiral cords are not present on the first teleoconch whorl; near the end of the second a small thread appears in the upper part, crossing over the axial ribs, forming nodules at the crossing points; in the third whorl there are three well defined spiral cords, and, on the last whorls, there are five, the subsutural one smaller and close to the next one. Below the end of the spire, there are five nodulous cords down to the base. The microsculpture (Figs. 11-13) is formed by small, short and interrupted threads which are present on the whole surface. Aperture rounded, peristome sharp, serrated due to the end of the spiral cords. There is an internal thickening on which 5-7 rounded nodules can be seen. No umbilicus. The columella is straight, with an everted border. Colour dirty white.

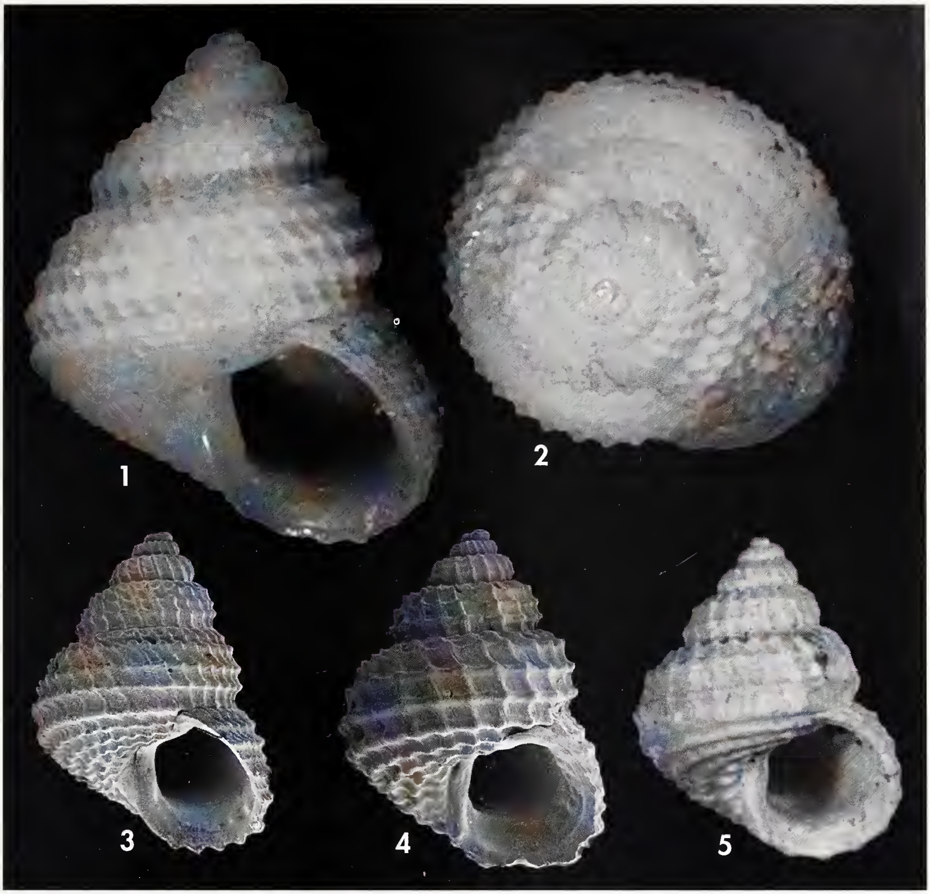
Dimensions: The holotype has a height of 3.5 mm.

Distribution: Presently known only from Lanzarote.

Remarks: The assignation of the present species to the genus *Putzeysia* was based on the description of this genus in Wenz (1938: 282) and the similarity with the European species *P. wiseri* (Calcara, 1842). Anyway, both species are very different because the new one is smaller than *P. wiseri* (which can reach 5.6 mm height: Figs. 1-2); the protoconchs are similar, but that of *P. wiseri* is somewhat larger (310 μm), less sculptured, the first whorl of the teleoconch has 17 axial ribs (vs. 12), and the microsculpture is denser.

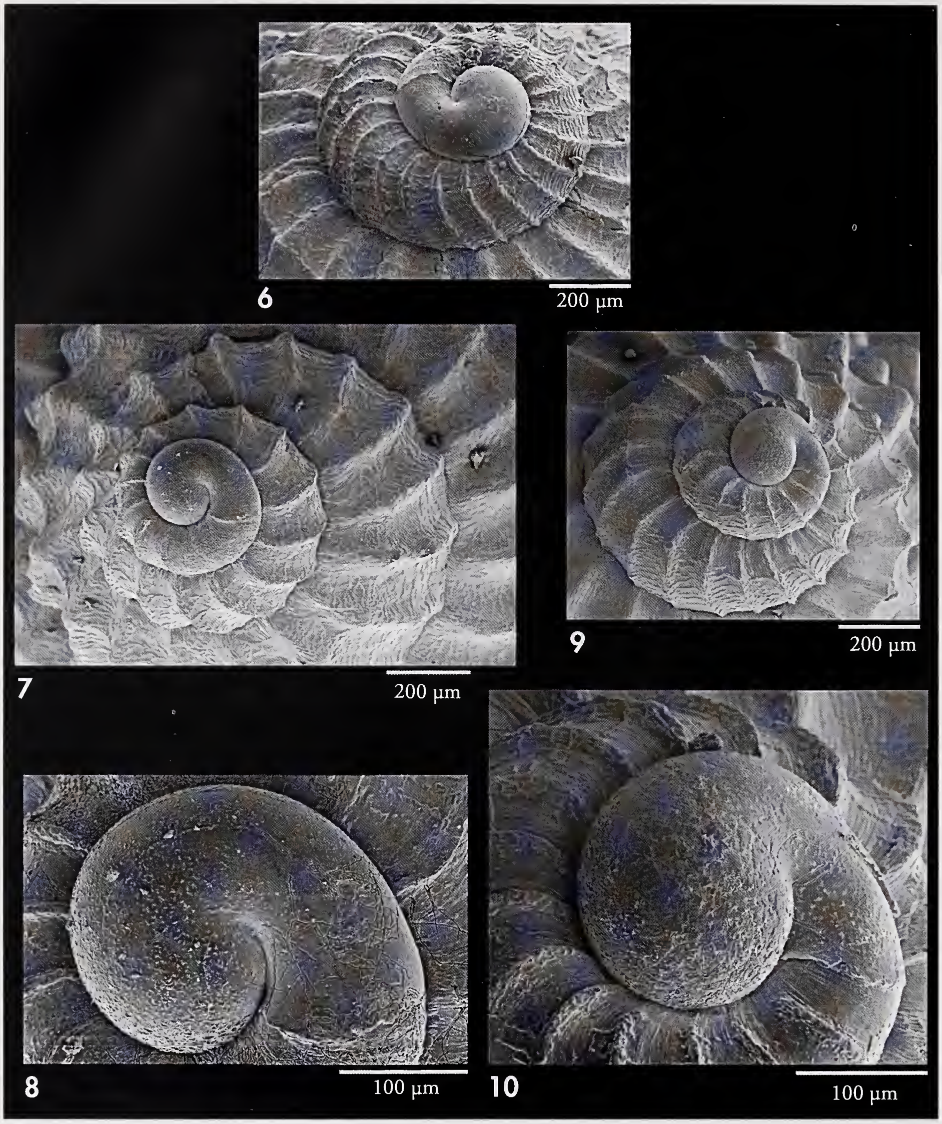
Putzeysia juttae spec. nov. (Figs. 4, 9, 10, 14-16)

Type material: Holotype (ZSM 20090101)(Figs. 4, 13) and five paratypes (ZSM 20090102). Paratypes in the following collections: MHNS (1), MNCN (1), MNHC (1), MNHN (1), SMNH (2), ZMH (2), ZMB (2), CWE (50) (all ex CWE, collected from 1999 to 2000).
Type locality: La Restinga, El Hierro, Canary Islands, 30-60 m.
Etymology: The species is named after Jutta Baumgartel, the wife of the leader of the diving school in acknowledgement for her help to the first author in many aspects of collecting, for the last ten years.



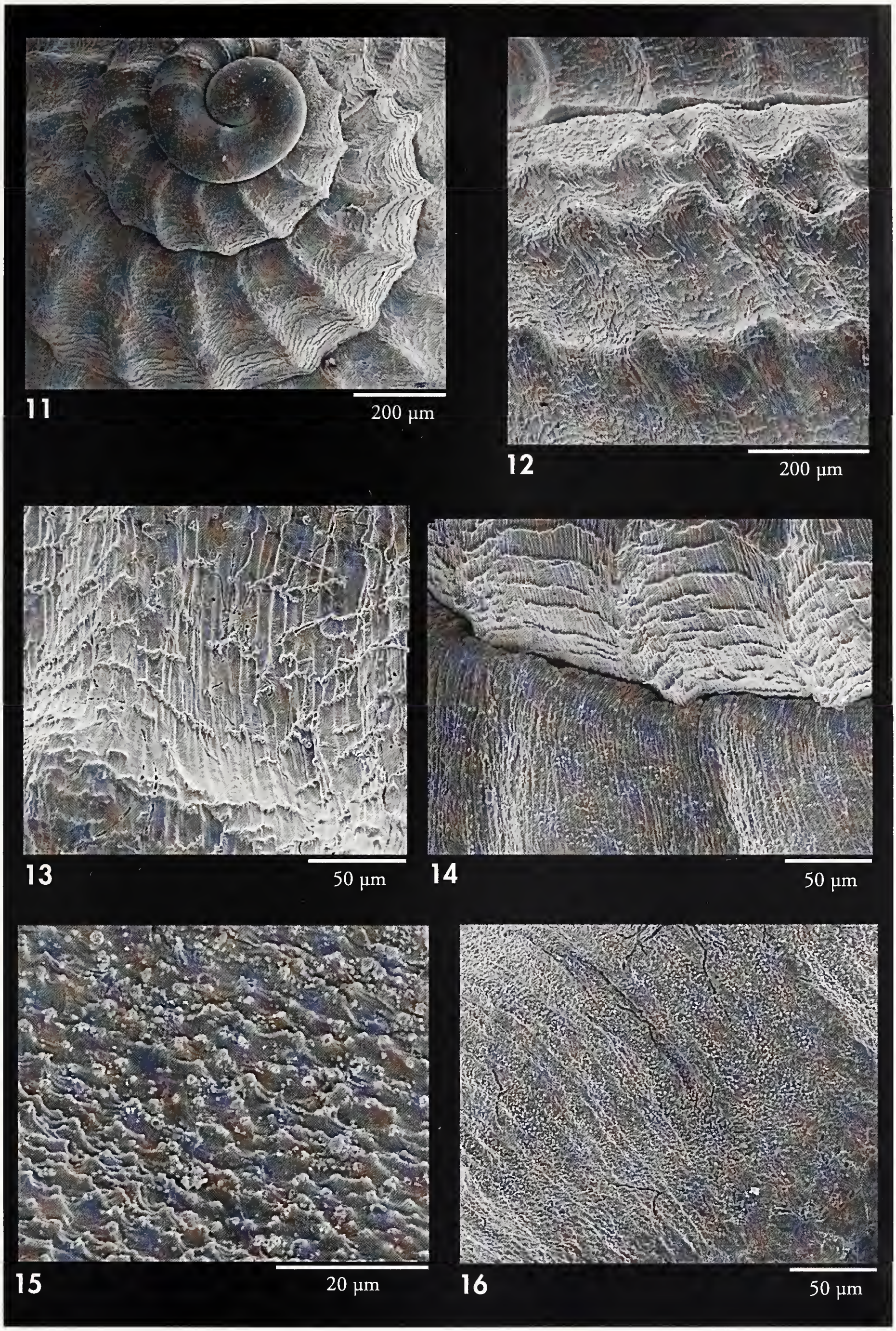
Figures 1-5. Shells of *Putseysia* spp, all to scale. 1, 2: *Putzeysia wiseri* (Calcara, 1842), 5.6 mm, Banca di Santa Lucia, Livorno, Italy, 400 m (CWE); 3: *P. franziskae* spec. nov. holotype, 3.5 mm, Lanzarote (ZSM); 4: *P. juttae* spec. nov., holotype, 3.8 mm, El Hierro (ZSM); 5: *P.* cf. *juttae,* Los Cancajos, Santa Cruz de La Palma, 40 m (CWE).
Figuras 1-5. Conchas de Putseysia *spp, a la misma escala. 1, 2:* Putzeysia wiseri *(Calcara, 1842), 5,6 mm, Banca di Santa Lucia, Livorno, Italia, 400 m (CWE); 3:* P. franziskae *spec. nov. holotipo, 3,5 mm, Lanzarote (ZSM); 4:* P. juttae *spec. nov., holotipo, 3,8 mm, El Hierro (ZSM); 5:* P. *cf.* juttae, *Los Cancajos, Santa Cruz de La Palma, 40 m (CWE).*

Description: Shell (Fig. 4) turbinoid, globose, with 4-4 ¾ spiral whorls of a rather quick development, last one rounded, representing more that 60 % of the total height. Protoconch (Fig. 9) with less than one whorl, a diameter of 270 μm and a nucleus of about 160 μm. Under strong magnification (Fig. 10), a microsculpture formed by small irregular projections can be observed. Teleoconch whorls with axial ribs: 16 on the first whorl, 17-18 on the second, 24-26 on the last whorl, which are strongly prosocline and narrower than the interspaces. The spiral cords are not present on the first teleoconch whorl; near the middle of the second whorl a small thread appears on the upper part, crossing over the axial ribs, forming nodules at the crossing points and increasing slowly; on the third whorl there are three well defined cords and, on the last



Figures 6-10. Protoconchs. 6: *Putzeysia wiseri* Santa Lucia (Livorno), Italy, 440 m; 7, 8: *P. franziskae* spec. nov. Lanzarote (ZSM); 9, 10: *P. juttae* spec. nov., El Hierro (ZSM).
Figures 6-10. Protoconchas. 6: Putzeysia wiseri *Santa Lucia (Livorno), Italia, 440 m; 7, 8:* P. franziskae *spec. nov. Lanzarote (ZSM); 9, 10:* P. juttae *spec. nov., El Hierro (ZSM).*

whorl, there are five, the subsutural one a little smaller in some shells than the subsequent ones. Below the end of the spire, there are four nodulous cords down to the base. The microsculpture (Figs. 14-16) is formed by small, short and interrupted spiral threads which are present on the first whorls. On the remaining shell surface numerous growth lines with many prominent tubercles can be seen under strong magnification. Aperture rounded, peristome narrow, serrated due to the ends of the spiral cords. There is an internal thick-



Figures 11-16. Details of microsculpture. 11-13: *P. franziskae* spec. nov., Lanzarote (ZSM); 14-16: *P. juttae* spec. nov., El Hierro (ZSM).
Figuras 11-16. Detalles de microescultura. 11-13: P. franziskae *spec. nov., Lanzarote (ZSM); 14-16:* P. juttae *spec. nov., El Hierro (ZSM).*

ening on which 6-7 rounded nodules can be seen. No umbilicus, but a narrow fissure. The columella is straight forming an everted border. Colour dirty white.

Dimensions: The holotype has a height of 3.8 mm.

Distribution: Known only from El Hierro, although one shell from La Palma (Fig. 5) could belong to this species.

Remarks: *Putzeysia juttae* spec. nov. is rather similar to *Putzeysia franziskae* spec. nov. and for this reason the differences with *P. wiseri* are the same as those previously mentioned, although it has 15 axial ribs on the first teleoconch whorl. It can be separated from *Putzeysia franziskae* because the latter has more axial ribs and cords at the base; the protoconch has a larger nucleus, and the microsculpture has a predominance of the very tuberculated axial growth lines instead of the irregular spiral threads which appears in *Putzeysia juttae.*

The presence of these two different species within one archipelago is surprising, considering that other close trochoid species with a similar protoconch do not show appreciable differences within one island or seamount group. In the genus *Danilia*, Dautzenberg and Fischer (1896) distinguished *Danilia affinis* as a different species from the Azores, but in the Canary islands we find the same species as in continental Europe. Something similar occurs with the genus *Clelandella* (see Gofas, 2005) which has different species in the Lusitanian bancs and in the Meteor group of seamounts, but shows no differentiation within seamounts or islands of the same group.

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Moluscos continentales de los alrededores de Molina de Aragón (Guadalajara, España), con notas sobre *Orculella bulgarica* (Hesse, 1915) (Gastropoda, Orculidae)

Non-marine molluscs of the surroundings of Molina de Aragón (Guadalajara, Spain), with notes on *Orculella bulgarica* (Hesse, 1915) (Gastropoda, Orculidae)

Fernando ROBLES* y Alberto MARTÍNEZ-ORTÍ**

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RESUMEN

La fauna malacológica de los alrededores de Molina de Aragón (Guadalajara) está compuesta por al menos 35 especies, 27 terrestres y ocho acuáticas, de las que 10 habían sido citadas anteriormente. La forma descrita como *Pupa dolium* Draparnaud var. nova por Westerlund (1897) se asigna a *Orculella bulgarica* (Hesse, 1915), de acuerdo con la revisión del material original. Esta especie está presente en 35 localidades del este de la Península Ibérica, distribuidas desde el límite Plio-Pleistoceno hasta la actualidad y ha sufrido una importante regresión en su extensión geográfica, que se limita en el presente a escasas localidades conocidas en un área muy restringida de la provincia de Granada.

ABSTRACT

The malacological fauna of the surroundings of Molina de Aragón (Guadalajara, Spain) is composed by at least 35 species, 27 terrestrial and eight aquatic, of which 10 had been mentioned previously. The morph described as *Pupa dolium* Draparnaud var. nova by Westerlund (1897) has been assigned to *Orculella bulgarica* (Hesse, 1915), following revision of the original material. This species is present in 35 localities of eastern Iberian Peninsula, distributed from the Plio-Pleistocene boundary to present, and has suffered an important regression in its geographical extension. Nowadays it is only known from few localities in a very restricted area of the Granada province.

INTRODUCCIÓN

WESTERLUND (1897) describió una variedad de "*Pupa dolium* Drp.", indicando que se trataba de una nueva variedad. El hecho de que se publicase en una corta nota presentada por el geólogo Salvador Calderón a la Sociedad Española de Historia Natural y publicada en las Actas de dicha Sociedad, dentro de una lista de "moluscos recogidos por él en Molina de Aragón" (sic), ha propiciado que este taxon haya pasado desapercibido por los malacólo-

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gos que se han ocupado de revisar la fauna de Pupillacea de la Península Ibérica. Los autores han muestreado en reiteradas ocasiones los alrededores de Molina de Aragón, en busca de ejemplares que puedan asignarse a este taxon, con resultados negativos. Sin embargo se ha localizado la muestra original, estudiada por Westerlund, que se encuentra depositada en el Museo Nacional de Ciencias Naturales. La revisión de este material ha permitido aclarar el estatuto taxonómico de esta especie, así como establecer la naturaleza, actual o fósil, de estos ejemplares, que en la nota de Calderón se prestaba a confusión. Por otra parte, los resultados obtenidos en las prospecciones de los autores aportan nueva información sobre la composición de la fauna malacológica de un área poco estudiada hasta ahora. De hecho, la lista de Westerlund, publicada por CALDERÓN (1897), sólo incluye las 10 especies siguientes: *Cornu aspersum* (O.F. Müller, 1774) (citada como *Helix aspersa* Müll.), *Iberus gualterianus alonensis* (Férussac, 1821) (*Helix alonensis* Fer.), *Xerosecta arigonis* (Schmidt, 1853) (*Helix Arigoi* (Rossm.) Bgt.), *Cernuella virgata* (Da Costa, 1778) (*Helix Dantezi* Kob., *Helix lauta* Lowe, *Helix luteata* Parr.), *¿Helicella madritensis*? (Rambur, 1868) (*Helix irrita* (Berth.) Bgt.), *Cochlicella acuta* (O.F. Müller, 1774) (*Helix acuta* Müll.), *Zebrina detrita* (O.F. Müller, 1774) (*Buliminus detritus* Müll.), *Jaminia quadridens quadridens* (O.F. Müller, 1774) (*Buliminus quadridens* Müll.), *Oxyloma elegans* (Risso, 1826) (*Succinea Pfeifferi* Rossm. var. *elata* Band.) y *Orculella bulgarica* (Hesse, 1915) (*Pupa dolium* Drp. var. nova West.).

MATERIAL Y MÉTODOS

La recogida de muestras se realizó los días 1, 2 y 3 de Noviembre de 2002: Las muestras se encuentran depositadas en el Museu Valencià d'Història Natural de Valencia. Las muestras fósiles se encuentran en la colección Robles (Departamento de Geología de la Universitat de València). La determinación de las especies se ha realizado por las características conquiológicas y, cuando estas no han sido suficientes, se ha realizado la disección y el estudio del aparato reproductor de los ejemplares.

Se han examinado dos muestras de "*Pupa dolium var. nova*" depositadas en el Museo Nacional de Ciencias Naturales de Madrid, MNCN-15.05/37017 (11 conchas) y MNCN-s/n (col. Azpeitia nº2481) (5 conchas), ambas procedentes de la recolección original de Calderón.

RESULTADOS

Moluscos de los alrededores de Molina de Aragón (Guadalajara)

Se han muestreado seis localidades, con los resultados que se indican en la Tabla I.

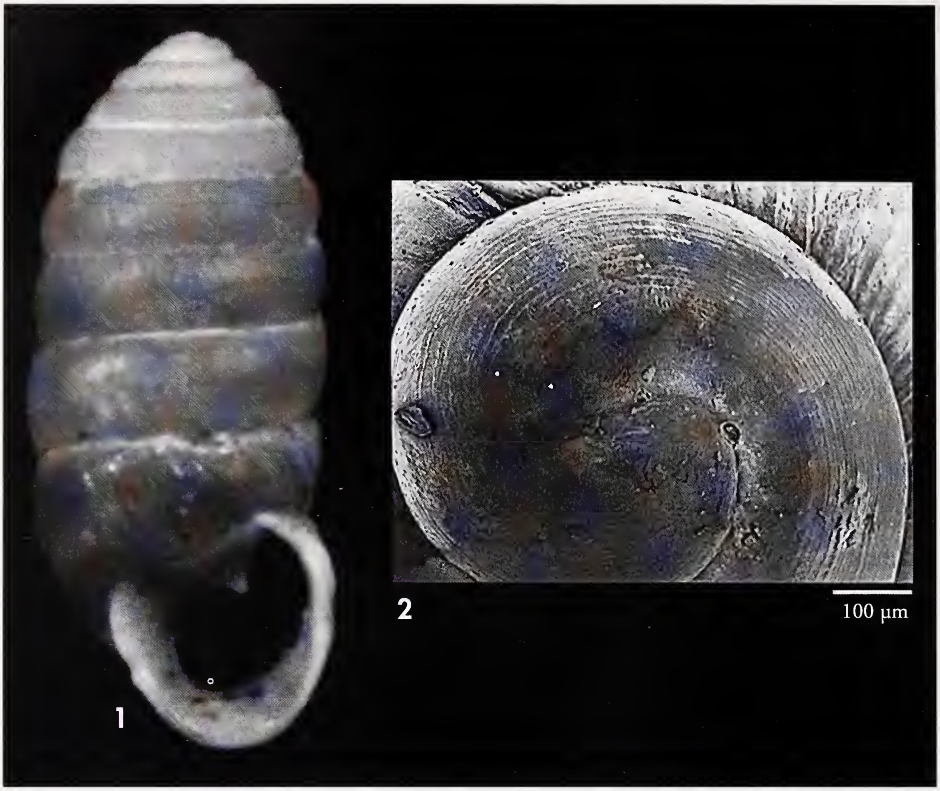
Sobre la identidad de "*Pupa dolium* Draparnaud. var. nova" (Westerlund 1897)

CALDERÓN (1897) indica que "se hallan en enormes cantidades las citadas variedades de *Succinea Pfeifferi* y *Pupa dolium* en los parajes que se encharcan durante la mayor parte del año en aquella región extremadamente húmeda". Esta observación parece indicar que se trata de especies actuales, que viven en la región. Sin embargo, en los muestreos realizados se han recogido numerosos ejemplares vivos de *Oxyloma elegans* (a la que sin duda se refiere la cita de Westerlund de "*Succinea Pfeifferi* Rossm. var. *elata* Band.") pero no se ha hallado ningún ejemplar, actual o fósil, de *Orculella bulgarica* (a la que se refiere la cita de "*Pupa dolium* Drp. *var nova*", como comentamos más adelante).

La consulta realizada al Stockholm Naturhistoriska Riksmuseet (K. Sindemark, e-mail del 26 de Agosto de 2002) y al Göteborgs Naturhistoriska Museum (T. Nordander, e-mail de 2 de Septiembre de 2002), en los que está depositada la colección Westerlund, ha dado resultado negativo. Las muestras estudiadas están depositadas en la Colección Malacológica del Museo

Tabla I. Listado de especies halladas en los alrededores de Molina de Aragón (Guadalajara). Puntos de muestreo: (1). Junto a Fábrica en la salida de Molina, aguas abajo del río Gallo, chopera en el margen izquierdo (UTM: 30TWL939213). (2). Márgenes del río Gallo, 2 km aguas abajo de Molina. Chopera (UTM: 30TWL898228). (3). Margen izquierda del río Gallo, chopera aguas arriba de Molina (UTM: 30TWL936214). (4). Margen derecha del río Gallo, a la salida de Molina. Presa y secano (UTM: 30TWL945194). (5). El Ponce. (UTM: 30TWL971207). (6). Subida al Castillo (UTM: 30TWL937223).
Table I. List of species collected in the surroundings of Molina de Aragón (Guadalajara). Sites: (1). Near a factory in Molina, downstream Gallo river, poplar woods on the left river bank UTM: 30TWL939213). (2). Gallo river banks, 2 km downstream from Molina. Poplar (UTM: 30TWL898228). (3). Gallo left river bank, poplar woods upstream from Molina (UTM: 30TWL936214). (4). Right bank of Gallo river, in Molina. Reservoir and dry field (UTM: 30TWL945194). (5). El Ponce (UTM: 30TWL971207). (6). Uphill towards the Castle (UTM: 30TWL937223).

Especies	Loc. 1	Loc. 2	Loc. 3	Loc. 4	Loc.5	Loc. 6
Oxyloma elegans (Risso, 1826)		X	X	X	X	
Cochlicopa lubrica (O.F. Müller, 1774)	X	X	X			
Vallonia costata (O.F. Müller, 1774)	X	X			X	
Pupilla muscorum (Linnaeus, 1758)					X	
Granaria braunii braunii (Rossmässler, 1842)						X
Jaminia q. quadridens (O.F. Müller, 1774)				X		X
Merdigera obscura (O.F. Müller, 1774)	X					
Zebrina detrita (O.F. Müller, 1774)				X	X	
Oxychilus cellarius (O.F. Müller, 1774)	X	X	X	X		
Zonitoides nitidus (O.F. Müller, 1774)			X	X		
Vitrina pellucida (O.F. Müller, 1774)	X	X				
Oligolimax annularis (Studer, 1820)					X	
Discus rotundatus (O.F. Müller, 1774)	X	X	X	X	X	
Deroceras laeve (O.F. Müller, 1774)	X					
Deroceras reticulatum (O.F. Müller, 1774)	X					
Milax nigricans (Philippi, 1836)	X					
Lehmannia valentiana (Férussac, 1822)	X					
Testacella haliotidea Draparnaud, 1801	X					
Arion intermedius Normand, 1852	X					
Arion hispanicus Simroth, 1886	X					
Monacha cartusiana (O.F. Müller, 1774)	X	X	X	X	X	
Xerosecta arigonis (Schmidt, 1853)	X	X	X	X	X	
Cernuella virgata (Da Costa, 1778)	X					
Helicella madritensis (Rambur, 1868)				X		
Cepaea nemoralis (Linnaeus, 1758)	X	X	X	X	X	
Iberus gualtieranus alonensis (Férussac, 1821)						X
Cornu aspersum (O.F. Müller, 1774)	X	X	X	X	X	
Potamopyrgus antipodarum (Gray, 1843)	X		X			
Physa acuta (Draparnaud, 1805)	X					
Lymnaea sp.	X					
Radix sp.	X		X			
Anisus spirorbis (Linnaeus, 1758)			X			
Ancylus fluviatilis O. F. Müller, 1774	X					
Pisidium subtruncatum Malm, 1855	X					



Figuras 1, 2. *Orculella bulgarica* de Molina de Aragón (Guadalajara, España), (MNCNs/n, col. Azpeitia nº2481; H=7,25 mm; Ø=3,20 mm). 1: ejemplar; 2: detalle de la escultura de la protoconcha.
Figures 1, 2. Orculella bulgarica *of Molina de Aragón (Guadalajara, Spain), (MNCNs/n, Azpeitia coll. nº2481; H=7.25 mm; Ø=3.20 mm). 1: specimen; 2: detail of the protoconch sculpture.*

Nacional de Ciencias Naturales de Madrid y están compuestas por un total de 16 conchas en buen estado de conservación. La disposición de los pliegues en la abertura coincide con la indicada en la descripción original (Westerlund in Calderón, 1897: 52): "*plica parietalis inmersa, brevi, tenui et plicis columellaribus profundissimis obsoletus distincta*". La morfología de la teleoconcha y la microescultura de la protoconcha (Figs. 1, 2) permiten asignar esta variedad a *O. bulgarica*, de acuerdo con las detalladas descripciones de esta especie realizadas por Gittenberger (1983) y Garrido *et al.* (2005). Las medidas de las conchas (Tabla II) quedan dentro de la variabilidad indicada por estos autores.

Las ejemplares estudiados no han sido recogidos vivos. Carecen de periostraco y presentan la abertura rellena de sedimento. Sin embargo, la comparación de su estado de conservación con el que presentan otras muestras de diversa edad geológica (véase más adelante), incluso holocenas, parece indicar un carácter muy reciente de las conchas de Molina de Aragón.

O. bulgarica fue descrita originariamente en Bulgaria y ha sido citada posteriormente en Rusia, Armenia y Turquía (véase información detallada en Garrido *et al.*, 2005). Es una especie ampliamente representada en el Este de la Península Ibérica desde el Plio-Pleistoceno hasta la actualidad, que ha sufrido una fuerte regresión de su área

Tabla II. Dimensiones de los ejemplares de "*Pupa dolium* var. nova" West. depositadas en el MNCN de Madrid.
Table II. Dimensions of the specimens of "Pupa dolium *var. nova" West. stored in the MNCN of Madrid.*

	máximo	mínimo	medio	máximo	mínimo	medio	máximo	mínimo	medio
Altura	7,8	6,6	6,9 ± 0,4	7,7	6,5	7,1 ± 0,5	7,8	6,5	7,0 ± 0,4
Diámetro	3,9	3,0	3,2 ± 0,2	3,3	3,2	3,2 ± 0,1	3,9	3,0	3,2 ± 0,2
n	11	11	11	5	5	5		16	
Muestra	MNCN 15.05/37017			MNCN s/nº (col. Azpeitia 2481)				Total	

de distribución. Dado que en las revisiones existentes (Gittenberger, 1983; Garrido, Arrébola y Bertrand, 2005; Arrébola y Garrido, 2008) se mencionan solamente unas pocas localidades, presentamos a continuación una recopilación de la distribución de esta especie (Fig. 3), basada en la información bibliográfica existente y en nuestros propios datos inéditos. La lista se ha confeccionado teniendo en cuenta la edad de las muestras y su localización geográfica, con las coordenadas UTM. Se añade la referencia bibliográfica cuando la localidad ha sido publicada previamente y el nombre del recolector (indicado por !), cuando se conoce.

Plio-Pleistoceno:

1.- Hellín (Albacete). 30SXH16. Jodot (1959). (Birot y Solé Sabarís!).

2.- Almenara (Castellón). Yacimiento Casablanca 1. 30SYK40. Bech, Villalta y Abad (1997). (J.F. de Villalta!, Martínez-Ortí!)

3.- Cofrentes (Valencia). 30SXJ64. Inédito. (Robles y Ruano!).

Pleistoceno medio:

4.- Ambrona (Soria). 30TWL45. Preece (1991) (Preece!).

5.- Redueñas (Madrid). 30TVL41. Inédito. (Hoyos y Robles!).

6.- Barranco de Pedro (Villarta, Cuenca). 30TXJ27. Inédito. (Collado y Robles!).

7.- Ermita de la Consolación (Villarta, Cuenca). 30TXJ26. Inédito. (Collado y Robles!).

8.- Mudarra (Huete, Cuenca). 30TWK24. Inédito (Daams!).

9.- Cúllar de Baza (Granada) 30SWG35. Robles (1989). (Alberdi!).

Pleistoceno superior:

10.- Can Ubach y Cementerio viejo de Rubí (Barcelona). 31TDF19. Almera (1894-1907); Almera y Bofill (1898); Bofill y Haas (1920). (Almera!).

11.- km 8,6 de la CC-1413, cerca de Rubí (Barcelona). 31TDF19. Abad, Puisségur y Calzada (1986).

12.- Vélez Rubio (Almería). 30SWG86. Brunnacker y Lozek (1969). (Brunnacker!).

13.- Almansa (Albacete). 30SXJ60. Inédito. (Robles y Ruano!).

Pleistoceno indiferenciado:

14.- Santes Creus (Tarragona). 31TCF67. Inédito (Torrens!)

15.- Horna (Guadalajara), 6 km al SW de Medinaceli. 30TWL45. Gittenberger (1983). Preece (1991). (Preece!).

16.- Riotovi (Soria), 13 km al W de Medinaceli (Guadalajara) 30TWL35. Gittenberger (1983), Preece (1991). (Preece!).

17.- 0,4 km al NE de Galera (Granada). 30SWG37. Gittenberger (1993). (Falkner!).

18.- Turbera de Padul (Granada). 30SVF49. Madurga (1970, 1973).

Holoceno:

19.- Cerro de la Virgen. Orce (Granada). 30SWG47. Gittenberger (1983) (Falkner!).

20.- Baides (Guadalajara), 20 km al SW de Medinaceli. 30TWL23. Gittenberger (1983), Preece (1991). (Preece!). (Ca. 2640 ± 70 años).

21.- Bicorp (Valencia). Inédito. 30SXJ93 (Peñalver!).

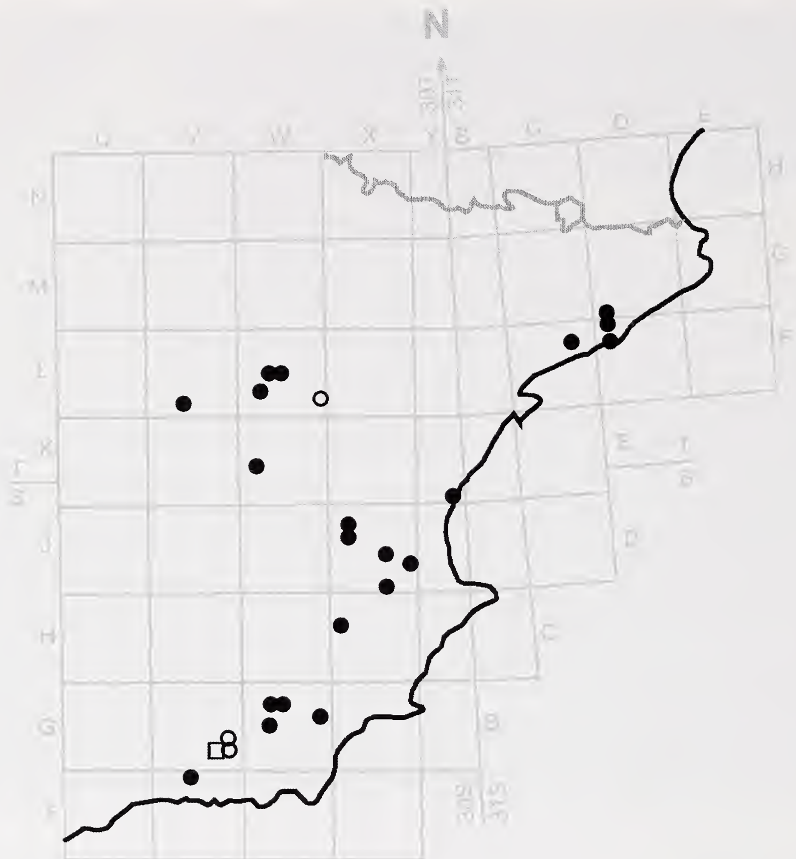


Figura 3. Distribución, actual y fósil, de *Orculella bulgarica* en la Península Ibérica (cuadrado: población actual; círculos blancos: poblaciones subactuales y recientemente extinguidas; círculos negros: poblaciones fósiles).
Figure 3. Distribution, recent and fossil, of Orculella bulgarica *in the Iberian Peninsula (square: recent population; open circles: subrecent and recently extinct populations; closed circles: fossil populations).*

Subactual y actual:

22.- Molina de Aragón (Guadalajara). 30TWL92. Westerlund en CALDERÓN (1897). Subactual.

23.- Fuente Alta de Potrera (Granada). 30SVG72. GARRIDO *ET AL.* (2005). Actual.

24.- Venta del Río de Cortes (Granada). 30SVG83. GARRIDO *ET AL.* (2005). Actual (extinguido).

25.- Fuente Seca de Cortes. 30SVG83. GARRIDO *ET AL.* (2005). Actual (extinguido).

26.- Fuente de la Rambla de la Viña. 30SVG82. GARRIDO *ET AL.* (2005) Actual (extinguido).

27-32.- ARRÉBOLA Y GARRIDO (2008) señalan la existencia de otras cinco poblaciones y una sexta localidad sólo con conchas recientes, sin indicar la situación exacta dentro de la provincia de Granada.

Sin datos o dudoso:

33.- Cerca de la estación de Martorell (Barcelona). 31TDF19. ALMERA Y BOFILL (1898), BOFILL Y HAAS (1920).

34.- Terrasa (Barcelona). 31TDG10. BOFILL Y HAAS (1920) (Almera y Bofill!).

35.- Torrelles de Llobregat (Barcelona). 31TDF17. BECH, VILLALTA Y ABAD (1997) (J. Bech!).

CONCLUSIONES

De acuerdo con nuestras prospecciones, la fauna malacológica de los alrededores de Molina de Aragón se compone de al menos 35 especies, de las que solamente 10 habían sido citadas previamente. De ellas, 27 son especies terrestres y ocho viven en ambientes acuáticos.

La cita de "*Pupa dolium* Drap. var. nova" por Westerlund corresponde a *Orculella burgarica* (Hesse). La especie no ha vuelto a ser encontrada, pero el estudio de la muestra original indica que los ejemplares fueron recogidos muertos, por lo que esta especie debe de ser eliminada del catálogo de moluscos actuales de la región.

El análisis de la distribución de esta especie, actual y fósil, en la Península Ibérica permite constatar la fuerte regresión que ha sufrido a lo largo del tiempo. Se conocen 35 localidades repartidas entre el límite Plio-Pleistoceno y la actualidad, de las que ocho permanecían inéditas y solamente en seis de ellas la especie continúa viviendo hoy en día.

AGRADECIMIENTOS

Al Dr. Torsten Nordander (Göteborgs Naturhistoriska Museum) y a Mrs. Karin Sindemark (Stockholm Naturhistoriska Riksmuseet) por su información sobre la colección Westerlund. Al Dr. Oscar Soriano por el envío del material del MNCN de Madrid y al Dr. Enrique Peñalver por su colaboración en los muestreos. Finalmente al S.C.S.I.E. de la Universitat de València por su ayuda en la realización de la fotografía realizada en el M.E.B Hitachi S-4100.

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Geographical notes on Iberian Caudofoveata (Mollusca)

Notas geográficas sobre los Caudofoveata (Mollusca) ibéricos

Luitfried v. SALVINI-PLAWEN*

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ABSTRACT

New records of Caudofoveata from samplings off Barcelona and off Galicia are presented. They concern *Chaetoderma(?) strigisquamatum* transferred to *Falcidens* and *F. vasconiensis* as well as two other species of *Falcidens* and two of *Prochaetoderma* s.l. This represents a noteworthy enlargement of the known geographical distribution. Some organisational characters of the species are added.

RESUMEN

Se presentan nuevas citas de Caudofoveata procedentes de las costas de Barcelona y Galicia: *Chaetoderma(?) strigisquamatum* transferido en *Falcidens* y *F. vasconiensis*, asi como otras dos especies de *Falcidens* y dos de *Prochaetoderma* s.l. Se amplia el conocimiento de su distribución geográfica y se añaden algunos caracteres en la organización de las especies.

INTRODUCTION

Caudofoveata are worm-shaped molluscs of generally 2-30 mm but up to 40 cm in length that burrow in marine sediments in depths of 50-9000 m, under special conditions as shallow as 3 m. They are externally characterised by an aplacophoran mantle with chitinous cuticle as well as unicellularly produced aragonitic sclerites; together with the Solenogastres, both clades reflect conservative levels of molluscan configuration (Salvini-Plawen, 2003, 2006). Currently, 125 species of Caudofoveata are described. Our knowledge of the diversity and distribution of the species in Iberian waters is still poor (cf. Salvini-Plawen, 1997). Apart from five taxa belonging to the bathial deep sea fauna of the eastern Atlantic, the known representatives of the Iberian shelf region include nine Caudofoveata species (cf. Salvini-Plawen, 1997; Scheltema and Ivanov, 2000). Material from more recent samplings revealed an enlargement of the geographical distribution of six species belonging to the Chaetodermatidae and Prochaetodermatidae.

MATERIAL EXAMINED

Caudofoveata were present in several samples from off Barcelona collected during the BIOMARE project (CTM2006-13508-C02-02) from the continental slope and canyon at 41° 03´ - 41° 15´ N, 02° 04´-02° 28´ E, 550-850 m (see Table I). This material was provided by Joan Cartes and Valeria Mamouridis from the Institut de Ciències del Mar (CMIMA-CSIC) in Barcelona.

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Table I. BIOMARE project and DIVA-Artabia sampling stations.
Tabla I. Estaciones de muestreo de los proyectos BIOMARE y DIVA-Artabria.

BIOMARE station	coordinates	depth	species
BIOM 1, BC 8 (27.02.07) (c. slope)	41°09´55"N, 02°25´59"E	850 m	*P. alleni*
BIOM 1, BC 10 (27.02.07) (c. slope)	41°09´55"N, 02°25´59"E	800 m	*F. strigisquamatus*
BIOM 2, BC 7 (april 2007) (c. slope)	41°10´00"N, 02°28´03"E	800 m	*F. strigisquamatus*
BIOM 2, BC 11 (april 2007) (canyon)	41°14´36"N, 02°26´58"E	600 m	*F. gutturosus*
BIOM 3, BC 3 (july 2007) (canyon)	41°14´36"N, 02°28´49"E	650 m	*F. gutturosus, F. aequabilis*
BIOM 3, BC 8 (july 2007) (c. slope)	41°10´01"N, 02 °26´25"E	800 m	*P. alleni*
BIOM 3, BC 14 (july 2007) (canyon)	41°03´52"N, 02°11´29"E	800 m	*F. strigisquamatus*
BIOM 3, BC 18 (july 2007) (canyon)	41°08´11"N, 02°04´37"E	650 m	*F. strigisquamatus*
BIOM 4, BC 3 (4.10.07) (canyon)	41°14´48"N, 02°26´28"E	650 m	*P. boucheti, P. alleni*
BIOM 4, BC 4 (4.10.07) (canyon)	41°14´48"N, 02°26´28"E	650 m	*P. alleni, F. aequabilis*
BIOM 8, BC 6 (feb. 2008) (canyon)	41°14´57"N, 02°27´00"E	550 m	*F. strigisquamatus*
DIVA-Artabria projects			
EBS-150 m (14.09.03)	43°33´N, 08°35´W		*P. boucheti*
EBS-162 m (03.07.06)	43°34´N, 08°36´30"W		*P. boucheti*
EBS-200 m (11.09.03)	43°40´N, 08°43´W		*P. boucheti*
EBS-250 m (14.09.02)	43°41´30"N, 08°45´W		*F. vasconiensis, P. boucheti*
EBS-300 m (13.09.02)	43°42´N, 08°46´W		*P. boucheti*
EBS-300 m (19.09.03)	43°42´N, 08°46´W		*F. vasconiensis*
EBS-400 m (13.09.02)	43°44´N, 08°48´W		*F. vasconiensis, P. boucheti*

Samples with Caudofoveata were also available from the DIVA-Artabria projects (PGIDT01PXI20008PE; CTM-2004-00740/MAR; PGIDT07PXIB000120PR) organised by Victoriano Urgorri (University of Santiago de Compostela) and conducted off NW-Galicia in the Gulf of Ártabro outside the Ria de Ferrol between 43° 28´ N, 08° 28´ W and 45° 43´ N, 09° 00´ W, at 100-1000 m depth; the samples were taken in September 2002, September 2003 and July 2006 using an epibenthic sledge (EBS) (Table I).

The holotype of *Chaetoderma(?) strigisquamatum* Salvini-Plawen (Muséum National d´Histoire Naturelle Paris no. 21094) has been re-examined with respect to the mantle sclerites.

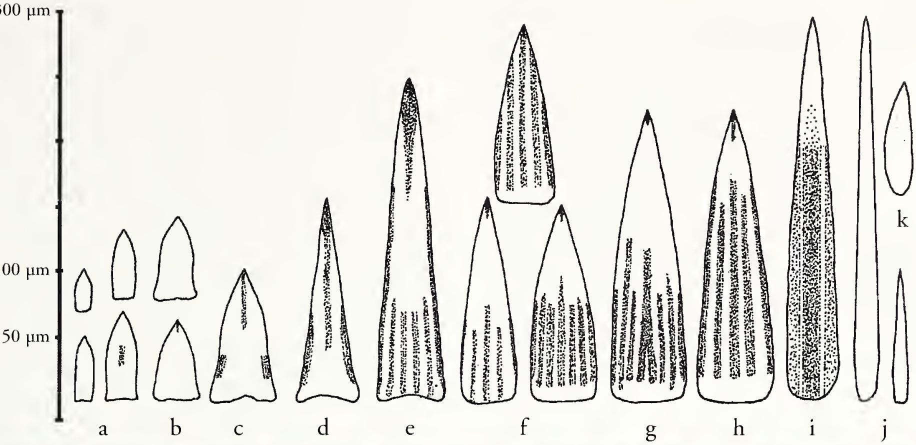
RESULTS

Family CHAETODERMATIDAE

Falcidens strigisquamatus (Salvini-Plawen, 1977)

Chaetoderma(?) strigisquamatum Salvini-Plawen, 1977. *Bull. Mus. Nat. Hist. Nat. Paris* 3e sér. (447), Zool 310: 419
[Type locality: Western Mediterranian Sea, Alborán Basin; 1491 m]

This species was known based on a single specimen from the Sea of Alborán and tentatively described under the genus *Chaetoderma(?)* (SALVINI-PLAWEN, 1977a). The investigations from off Barcelona yielded five additional individuals at 550-800 m (a voucher specimen is deposited in the Museo Nacional



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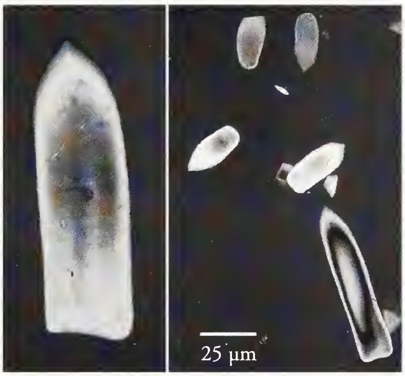

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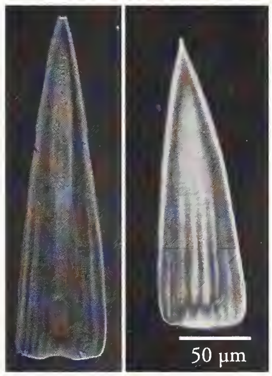

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Figures 1-4. *Falcidens strigisquamatus.* 1: mantle sclerites, a-b from the foregut region, c-e from the midgut region, f-h from the region of the midgut sac, h from the prepallial region, i-j from the pallial region, k from alongside the dorsoterminal sense organ; 2: mantle sclerite (60 x 20 µm) from the anterior foregut region of the holotype (see Figure 1a); 3: mantle sclerites from the anterior foregut region of specimen BIOM 3, BC 4; sclerite at left = 60 x 19 µm (see Figure 1a); 4: name-giving mantle scales from the regions of the midgut and midgut sac of specimen BIOM 3, BC 4 (see Figure 1e-g).

Figuras 1-4. Falcidens strigisquamatus. *1: escleritos del manto, a-b de la región anterior del tubo digestivo, c-e de la región media del tubo digestivo, f-h de la región del saco digestivo, h de la región prepaleal, i-j de la región paleal, k de la zona del órgano sensorial dorsoterminal; 2: escleritos del manto (60 x 20 µm) de la región anterior del tubo digestivo del holotipo (ver Figura 1a); 3: escleritos del manto de la región anterior del tubo digestivo del especimen BIOM 3, BC 4, esclerito de la izquierda 60 x 19 µm (ver Figura 1a); 4: escamas del manto, mostrando el dibujo que da nombre a la especie, de las regiones media del tubo digestivo y del saco digestivo, del especimen BIOM 3, BC 4 (ver Figura 1e-g).*

de Ciencias Naturales MNCN, Madrid, no. 15.01/0005): BIOM 1, BC 10 (1 ind., 8 mm); BIOM 2, BC 7 (1 ind., broken, anteriormost body region missing, 8.5 mm); BIOM 3, BC 14 (1 ind., 22 mm); BIOM 3, BC 18 (1 ind., 19 mm) (voucher specimen in MNCN); BIOM 8, BC 6 (1 ind., anteriormost body region missing, 15.5 mm)

Beyond the biogeographical data, some organisational features are added

here to supplement the original description (holotype re-examined in Sept. 2008): (1) The species reaches a body length of 22 mm and occasionally the posteriormost region (of the pallial cavity) shows some orange incrustation. (2) The sclerites of the mantle cover (Fig. 1) at the middle and posterior body (region of midgut sac, "posterior trunk") are 140-350 μm long and of the special type to which the name is alluding. These elongate scales have longitudinal ridges and furrows of different number and length (Salvini-Plawen, 1977a; Figs 1 f-h and 4) and sometimes are slightly asymmetrical. The scales of the midgut region ("anterior trunk"; Fig. 1 c-e) are almost radially arranged. The sclerites of the anterior body (foregut region, "neck") show some variation correlated to the size (age) of the specimens: Large individuals possess a characteristic type of small, slender scales ranging from 30 x 12 μm to 70 x 25 μm and 75 x 18 μm (Figs 1 a, 2, 3), which in smaller animals of up to 9 mm in length (re-examined holotype and other) are only sporadically present. In contrast, smaller specimens possess in the anterior body region roughly triangular scales (Fig. 1 b), which are scarce in large animals. (3) The pedal shield (about 300 x 200 μm) is preorally fused by a not very prominent narrow portion (Fig. 6). (3) The frontally bilobed cerebral ganglion has a distinct lobus impar. (4) The radula, scarcely visible in transparent whole mounts (see holotype), is represented by a pair of sickle-shaped teeth as is characteristic for the genus *Falcidens* (Salvini-Plawen 1968); the teeth are about 45 μm long and no symphysis could be discerned. In the largest specimen, the whole apparatus (Fig. 5) showed an un-reinforced basal cone only 105 μm long (50 μm wide, 20 μm thick), the two short lateral supports (55 μm long, 50 μm wide) and small muscular radula bolsters ("odontophores"; 80 x Ø 50 μm).

Falcidens vasconiensis Salvini-Plawen, 1996

Falcidens vasconiensis Salvini-Plawen, 1996. *Bull. Soc. Zool. France* 121: 341.
[Type locality: East Atlantic, SE Bay of Biscay, Cap Breton; 141-170 m]

The species had been described from the southeastern-most region of the Bay of Biscaya (Salvini-Plawen, 1996, 1999). The new records with three individuals at 250 m (4.5 mm), 300 m (5.5 mm) and 400 m (3 mm) evidence the presence of the species also off NW-Galicia.

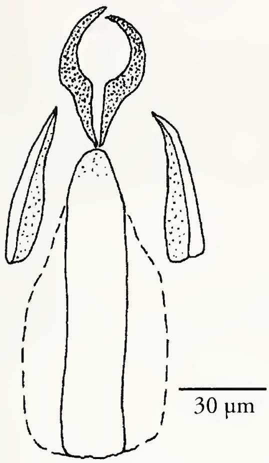
The mantle sclerites of the present specimens show some individual variation but are typical for *F. vasconiensis* (Fig. 3 in Salvini-Plawen, 1999). The radula apparatus of the smallest specimen (3 mm) with two pairs of lateral supports confirms the conspecificity (cf. Fig. 4 in Salvini-Plawen, 1999); only the pair of sickle-shaped teeth (pincers; 45 μm long) and the distal portion of the basal cone are reinforced. The pedal shield (about 150 x 135 μm) laterally flanks the mouth opening (Fig. 6).

Family Prochaetodermaidae

Prochaetoderma boucheti Scheltema and Ivanov, 2000

Prochaetoderma boucheti Scheltema and Ivanov, 2000. *Journ. Moll. Stud.* 66: 336
[Type locality: Western Mediterranean Sea, off Ceuta (Morocco); 425 m]

This species had been partly confused with the sympatric *P. iberogallicum* Salvini-Plawen, 1999, from which it differs by two rows of pedal shield scales and by the (likewise short, up to 135 μm) elongate midbody sclerites pro-



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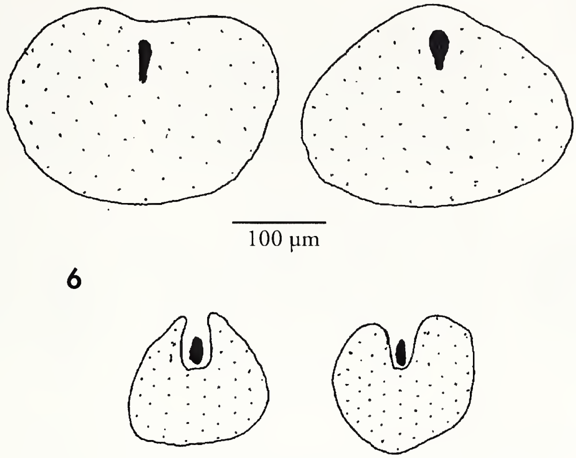

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Figure 5. *Falcidens strigisquamatus*, hard parts of the radula apparatus; basal cone outlined in natural position and when turned into the plane (dashed line). Figure 6. Pedal shields of *Falcidens strigisquamatus* (above) and *Falcidens vasconiensis* (below).
Figura 5. Falcidens strigisquamatus, *partes duras del aparato radular; barra basal dibujada en su posición natural y doblada sobre el plano (línea discontinua). Figura 6. Escudos pedios de* Falcidens strigisquamatus *(arriba) y* Falcidens vasconiensis *(abajo).*

vided with a distal median keel (SCHELTEMA AND IVANOV, 2001). In some regions it is also sympatric with *P. alleni* (below): Apart from the published Iberian distribution of *P. boucheti* from the southern Bay of Biscay, the Gulf of Cádiz, from off Ceuta and from off Málaga (SCHELTEMA AND IVANOV, 2000, 2001), additional findings can be reported.

There are several records of *P. boucheti* from Galicia outside the Ria de Ferrol at 150-400 m, predominantly at 150 m. In addition, a single specimen was found off Barcelona with BIOM 4, BC 3 (650 m).

Prochaetoderma alleni (Scheltema and Ivanov, 2000)

Spathoderma alleni Scheltema and Ivanov, 2000. *Journ. Moll. Stud.* 66: 358
[Type locality: East Atlantic, Bay of Biscay; 860 m]

The species is known from Iceland to the Mediterranean (IVANOV AND SCHELTEMA, 2001) and in some regions it is sympatric with *P. boucheti* (above); its easternmost record comes from the Aegean Sea close to Limnos (emendation of SALVINI-PLAWEN, 1977a: Stat. DS-08/14). It is characterised by three rows of pedal shield scales and by the somewhat longitudinally rotated and asymmetrical midbody sclerites (up to 250 µm).

The known Iberian distribution refers to the southern Bay of Biscay, to off central Portugal, to the Gulf of Cádiz and to off Morocco (off Ceuta to off Melilla; cf. SCHELTEMA AND IVANOV, 2000). There are four new records from off Barcelona: BIOM 1, BC 8; BIOM 3, BC 8 (4 mm long with up to 300 µm long scales); BIOM 4, BC 3; BIOM 4, BC 4.

Biogeographically, these findings border the occurrence of *P. alleni* from off Banyuls-sur-Mer/Côte Vermeille (Mediterranean coast of France: SALVINI-PLAWEN, 1977B; SCHELTEMA AND IVANOV, 2000).

Additional species

The presence of other Caudofoveata species from off Barcelona has already been communicated (SALVINI-PLAWEN, 1997). There are additional records of *Falcidens gutturosus* (Kowalevsky, 1901) from BIOM 2, BC 11 and BIOM 3, BC 3, as well as of *Falcidens aequabilis* Salvini-Plawen, 1972, from BIOM 3, BC 3 and BIOM 4, BC 4.

ACKNOWLEDGEMENTS

The author is very grateful to Mag. Emanuel Redl (Vienna) for assistance in preparing the photographs and to Dr. Michael Stachowitsch (Vienna) for polishing the English text.

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Iberus, 27 (2): 113-154, 2009

Las especies de *Chauvetia* Monterosato, 1884 (Mollusca, Neogastropoda) de Canarias y el área oeste africana de Mauritania y Sahara

The species of *Chauvetia* Monterosato, 1884 (Mollusca, Neogastropoda) from the Canary islands and the Western African area of Mauritania and the Sahara

Joan Daniel OLIVER* y Emilio ROLÁN**

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RESUMEN

Se revisan las especies del género *Chauvetia* Monterosato, 1884 encontradas en el área comprendida entre el archipiélago canario y la costa oesteafricana de Mauritania y Sahara. Se estudian 18 especies de las que 9 son descritas como nuevas.

ABSTRACT

The species of the genus *Chauvetia* Monterosato, 1884 found in the area including the Canaries archipelago and the African coast of Mauritania and the Sahara are revised. 18 species are studied of which 9 are described as new species.

INTRODUCCIÓN

El género *Chauvetia* Monterosato, 1884 se encuentra extendido desde el Mediterráneo, el Atlántico europeo, Canarias y la costa oeste africana desde Marruecos hasta Ghana. Se conocen algunas especies de este género desde hace muchos años y las descripciones de muchos taxones ha hecho que, unido a la variabilidad intraespecífica, el grupo tenga grandes dificultades para una completa y correcta ordenación y presente bastantes taxones, muchos de ellos sinónimos.

Se debe mencionar aquí que la variabilidad morfológica y cromática puede ser muy importante en el género *Chauvetia,* y por ello no se puede hacer una separación simplista basada en unos pocos caracteres. Como ejemplo sirva mencionar que una concha de color castaño oscuro puede pertenecer a alguna de estas especies: *Chauvetia brunnea, C. affinis, C. turritellata, C. crassior, C. tenebrosa* y *C. mamillata,* entre otras. Por otro lado, la misma especie, como por ej., *Chauvetia crassior,* puede ser blanca, amarilla, castaña clara, castaña muy oscura, con bandas castañas y blancas, etc.

SABELLI, GIANNUZZI-SAVELLI Y BEDULLI (1991) citan para el Mediterráneo 15 especies de *Chauvetia* que fueron descritas en 8 géneros diferentes y con unos 26 sinónimos, aún sin estar todos ellos exhaustivamente referidos.

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NORDSIECK (1976) hace una revisión sobre este grupo, pero estamos de acuerdo con MICALI (1999) en que este trabajo está lastrado por una gran cantidad de errores y erratas interpretativas.

NORDSIECK Y GARCÍA-TALAVERA (1979) incluyen en su trabajo las especies de Canarias describiendo nuevos taxones. MICALI (1999) hizo una revisión de las especies de este género, pero principalmente de aquellas del Mediterráneo occidental y el Atlántico próximo. OLIVER Y ROLÁN (2008) estudiaron las especies del área de Dakar.

Está en marcha un nuevo estudio del conjunto de las existentes en el Mediterráneo, estrecho y Atlántico próximo y, en ese trabajo, se tratará de volver a revisar todo el género con las nuevas aportaciones existentes, especialmente con el estudio de nuevo material y la observación de protoconcha y escultura al microscopio electrónico de barrido.

Mientras tanto, la reunión de una gran cantidad de ejemplares y conchas del área de estudio y próximas procedente de las colecciones de José Pedro Borges de Lisboa, José María Hernández de Canarias, Peter Ryall de Maria Rain, Austria, Frank Swinnen de Lommel, Bélgica, y del Museo Nacional de Historia Natural de Paris, hizo posible la revisión del género por encima del área de Dakar que ya habían sido estudiada en un trabajo anterior (OLIVER Y ROLÁN, 2008). En el presente trabajo, el área de estudio, como se ha indicado, comprende la costa africana de Mauritania y Sahara Occidental, así como el archipiélago de Canarias próximo a estas costas.

Abreviaturas

MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Museo national d'Histoire naturelle, Paris
MNHC Museo de la Naturaleza y el Hombre de Tenerife, Canarias
MHNS Museo de Historia Natural, Santiago de Compostela, (colección E. Rolán)
CFS colección de Frank Swinnen, Lommel,
CHO colección de José María Hernández Otero, Gáldar, Gran Canaria
CPB colección de José Pedro Borges, Lisboa
CPR colección de Peter Ryall, Maria Rain, Austria
ej ejemplar con partes blandas
c concha vacía
j juvenil

PARTE TAXONÓMICA

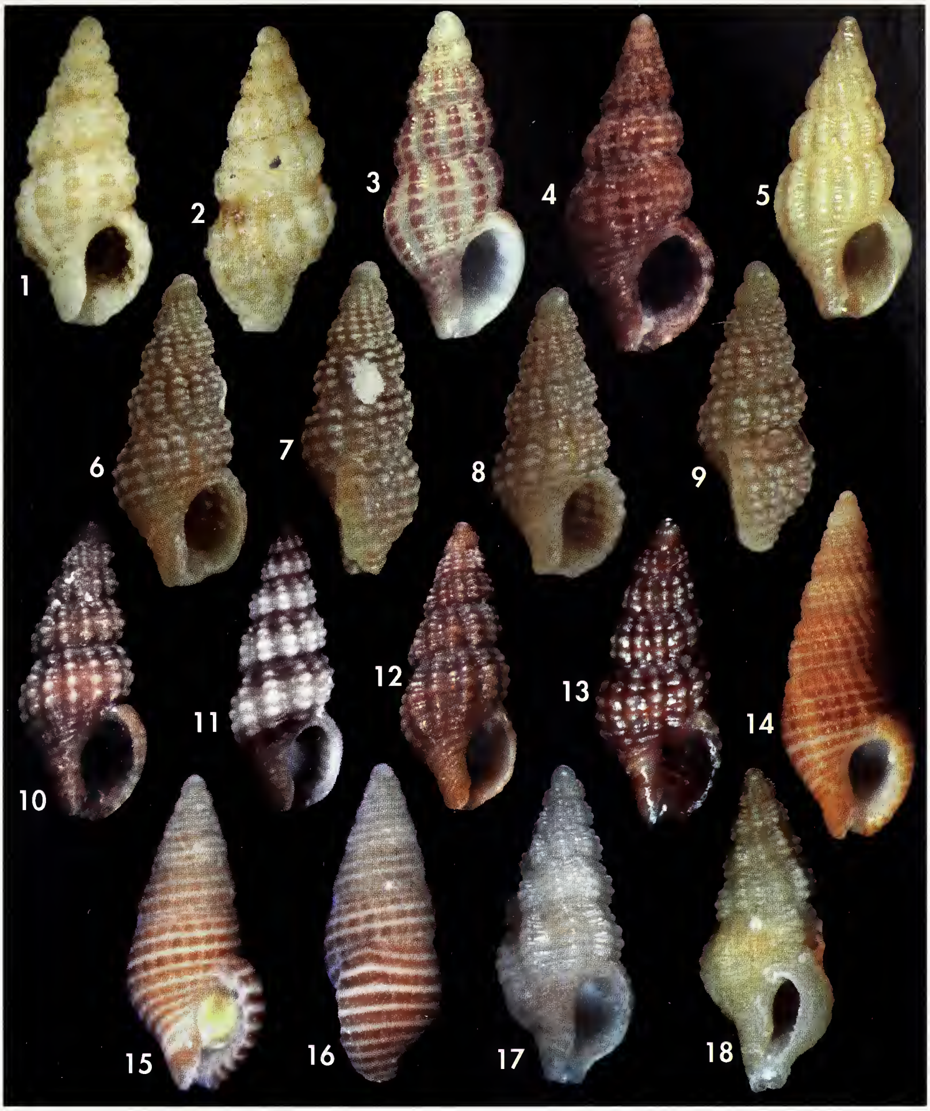
Familia BUCCINIDAE
Género *Chauvetia* Monterosato, 1884

Chauvetia mamillata (Risso, 1826) (Figs. 1-5)

Nasaea mamillata Risso, 1826. *Hist. Nat... Alpes-Marit.*, p. 223, lám. 5, fig. 69. [Localidad tipo: Alpes maritimes, Francia].

Material tipo: Lectotipo en MNHN (Figs. 1-2) (6,3 mm).
Material estudiado: CANARIAS: Gran Canaria: 2 c (CPR); Lanzarote: 1 c, Ref: 322050401, Formiche (CHO); 1 c, Playa Honda, Lanzarote (CHO); 5 c, Puerto del Carmen (CFS). SAHARA: 1 c, barcos de pesca (MHNS).

Comentarios: *C. mamillata* se diferencia de *C. affinis* o de *C. brunnea* por su mayor tamaño (algo más de 6 mm frente a algo más de 5 mm). Además de *C. affinis* se distingue por ser proporcionalmente más ancha y por tener un aspecto más sólido. Esta especie es poco frecuente en la zona y será tratada en el trabajo referido a las especies mediterráneas que está en marcha.



Figuras 1-5. *Chauvetia mamillata* (Risso, 1826), 1-2: lectotipo, 6,3 mm (MNHN); 3: 6,6 mm, Cerdeña; 4: 6,2 mm, Agaete, NO Gran Canaria (CPR); 5: 5,9 mm, Lanzarote. Figuras 6-13. *Chauvetia affinis* (Monterosato, 1889): 6-9: 2 sintipos, 4,8, 4,5 mm, Ognina (MNHN, coll. Locard); 10: forma *affinis*, 5,3 mm, Tarajalillo, Gran Canaria; 11: forma bandeada, 5,5 mm, Tenerife; 12, 13: forma oscura, 4,8, 5,2 mm, Granillo, Fuerteventura. Figuras 14-16. *Chauvetia lefebvrii* (Maravigna, 1840), 14: 7,8 mm, Tarifa, Cádiz; 15-16: 6,2 mm, Sahara. Figuras 17, 18. *Chauvetia procerula* (Monterosato, 1889); 17: 5,2, NO Gran Canaria; 18: 5,0 mm, Gran Canaria.

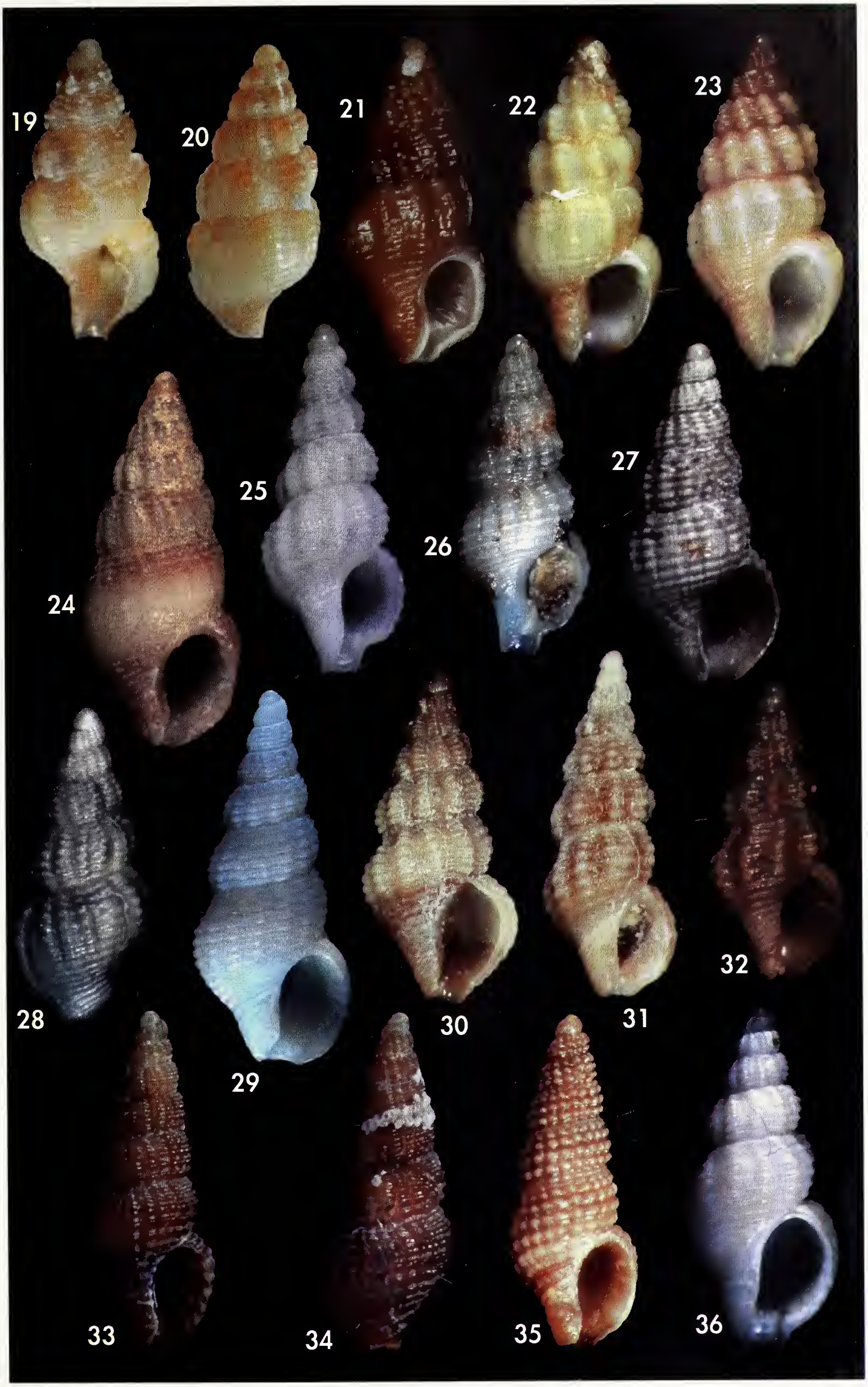
Figures 1-5. Chauvetia mamillata *(Risso, 1826), 1-2: lectotype, 6.3 mm (MNHN); 3: 6.6 mm, Cerdeña; 4: 6.2 mm, Agaete, NW Gran Canaria (CPR); 5: 5.9 mm, Lanzarote. Figures 6-13.* Chauvetia affinis *(Monterosato, 1889): 6-9: 2 syntypes, 4.8, 4.5 mm, Ognina (MNHN, coll. Locard); 10: form* affinis, *5.3 mm, Tarajalillo, Gran Canaria; 11: banded form, 5.5 mm, Tenerife; 12, 13: dark form, 4.8, 5.2 mm, Granillo, Fuerteventura. Figures 14-16.* Chauvetia lefebvrii *(Maravigna, 1840), 14: 7.8 mm, Tarifa, Cádiz; 15-16: 6.2 mm, Sahara. Figures 17, 18.* Chauvetia procerula *(Monterosato, 1889); 17: 5.2, NW Gran Canaria; 18: 5.0 mm, Gran Canaria.*

C. affinis (Monterosato,1889) (Figs. 6-13, 68-76)

Fusus turritellatus auct. non Deshayes, 1835. *Exp. Sc. de Morée*: 174, lám. 19, figs. 43-45. [Localidad tipo: Morée, hoy Peloponeso, Grecia].
Donovania affinis Monterosato, 1889. *Journ. de Conch.*, 37: 116. [Localidad tipo: Casablanca, Marruecos, Taormina, Sicilia y Pantellaria]

Material tipo: *C. affinis*: 2 posibles sintipos (MNHN, coll. Locard) (Figs. 6-9).
Otro material estudiado: CANARIAS: Gran Canaria: 1 c, La Isleta (CFS); 2 j, Maspalomas (CFS); 2 j, C0020a (CHO); 1 c, Caleta Abajo, lote 230, locC0014 (CHO); 1 j (CFS); 10 c, 4 j, Castillo del Romeral (CFS); 6 c Playa de Gran Canaria (CFS); 1 c, 1 j, Sardina, 10 m, NO Gran Canaria, arena y rocas (CHO); 12 c, Playa Honda (CFS); 7 c, 1 f, Playa del Hombre (CFS); 2 c, 1 j, Gando, 12 m, en *Cymodocea* (CHO): 11 c, C0014; 3 c, C0037 (CHO); 1 c, 1 j, Tarajalillo (CHO); 12 c, Tarajalillo (MNHN); 1 j, Tarajalillo (CFS); 1 j, Quintanilla, 20/07/93 (MNHN); 20 c, 20 j, Las Canteras (CFS); 1 c, Gando, 8,2483 (MNHN); 2 c, Las Canteras (CFS); 1 c, NO Gran Canaria (CFS); 1 c, Bañadores, 060384 (MNHN); 1 j, Roque, Taliarte, 28 m (MNHN); 10 c, Gando, Gran Canaria (CHO); 1 c, 2 j, Tarajalillo, 22-23 m (CPR); 2 ej, 5c, Sardina, 15 m (CHO); 7 c, C0022 (CHO); 10 c, Tarajalillo (CHO); 4 c, 1 j, Quintanilla, en pozas (CHO); más de 200 ej y c, Arinaga, 15 m (CFS). Isla de la Palma: 3 c, Tazacorte, 6 m (MNHN). Lanzarote: 8 c, 5 j, 1 j, Isla Graciosa (CFS); 2 j, La Sabina, 40 m (CFS); 2 c, Playa Honda, Arrecife, (CHO); 1 j, Pecheguera (Lanzarote); 2 c, Pecheguera (MNHN); 1 c, Playa Honda (CHO); 1 c, 1j, Pto del Carmen, 40 m (CHO); 1 c, Playa Honda, intermareal, Arrecife (CHO); 1 c, Bañadores, 060384 (CHO); 2 c, Granillo (CHO); 4 ej, 5 c, 2 j, Las Coloradas, intermareal (MNHN); 2 c, Pecheguera, intermareal (MNHN); 5c, Arrecife intermareal (MNHN); 10 c, 4 j, Puerto del Carmen, 34-45 m (CFS). Tenerife: 1 c, Los Cristianos (CFS); 1 ej, st08/04-03, Punta Teno, (CPB); 1 j, 03/10/07 Punta Teno (CPB); 1 ej, 11/05/06 Punta Teno (CPB); 1 c, Agua Dulce, 3-7 m (MNHN); 1 c, La Tejita, intermareal (MNHN); 1 ej, 2 c, 1 j, Palm–Mar, (MNHN); 6 c, C0019; 4 c, C0010 (CHO); 1 c, C0014 (CHO); 4 c, La Tejita, intermareal (MNHN); 1 j, Palm-Mar, 6-8 m (MNHN); 1 c, Los Burros (CHO); 1 c, CFV065 (CHO); 2 c, C0014 (CHO); 1 c, Bañadores, 06/03/84 (CHO); 1 c, C0005 (CHO); 1 c, C0009 (CHO); 1 c, 1 j, 1 f, FH67 (CHO); 1 c, lote 2419 (MHNS); 21 c, 7 j, Punta Teno, entre intermareal y 3 m (CPB). Fuerteventura: 8 c, Ajui, (CHO); 1 c, 3 j, FH67 (CHO); 3 c, 7 j, RH033 (CHO); 2 c, C0010 (CHO). SAHARA: 1 j, lote 207, 23º 08′ N, 16º 25′ W (CHO); 1 c, 1 j, lote 208, 23º 08′ N, 16º 25′ W (CHO); 1 c, lote 272, 22º 05′ N, 17º 11′ W (CHO); 5 c, 249 (MHNS).

(Página derecha) Figuras 19-23. *Chauvetia crassior* (Odhner, 1932); 19, 20: holotipo, 5,3 mm (SMNH); 21-23: 6,4, 6,6, 7,1 mm, Sardina, Gran Canaria; 24: *Chauvetia* cf. *crassior* (Odhner, 1932), 8,8 mm, Cabo Blanco, Mauritania (CFS). Figuras 25, 26. *Chauvetia lamyi* Knudsen, 1956; 25, 26: 7,5, 6,2 mm, Sahara. Figuras 27-30. *Chauvetia javieri* Oliver y Rolán, 2008; 27-29: 7,3, 6,7, 8,3 mm, Barcos de Pesca, Sahara; 30: paratipo, 7,6 mm, Dakar, Senegal (MNHN). Figura 31. *Chauvetia joani* Oliver y Rolán, 2008, paratipo, 6,9 mm, Dakar, Senegal (MHNS). Figura 32. *Chauvetia tenebrosa* Oliver y Rolán, 2008, 4,6 mm, Baie de l'Étoile, Nouahdibou, Mauritania. Figuras 33-35. *Chauvetia errata* spec. nov.; 33-34: holotipo, 7,0 mm, Cape Rouge, Mision Gruvel (MNHN); 35: 5,7 mm, Dakar, Senegal. Figuras 36. *Chauvetia megastoma* spec. nov. holotipo, 7,2 mm, Mauritania (MNCN).
(Right page) Figures 19-23. Chauvetia crassior *(Odhner, 1932); 19, 20: holotype, 5.3 mm (SMNH); 21-23: 6.4, 6.6, 7.1 mm, Sardina, Gran Canaria; 24:* Chauvetia *cf.* crassior *(Odhner, 1932), 8.8 mm, Cap Blanc, Mauritania (CFS). Figures 25, 26.* Chauvetia lamyi *Knudsen, 1956; 25, 26: 7.5, 6.2 mm, Sahara. Figures 27-30.* Chauvetia javieri *Oliver y Rolán, 2008; 27-29: 7.3, 6.7, 8.3 mm, Fishing ships, Sahara; 30: paratype, 7.6 mm, Dakar, Senegal (MNHN). Figure 31.* Chauvetia joani *Oliver y Rolán, 2008, paratype, 6.9 mm, Dakar, Senegal (MHNS). Figure 32.* Chauvetia tenebrosa *Oliver y Rolán, 2008, 4.6 mm, Baie de l'Étoile, Nouahdibou, Mauritania. Figures 33-35.* Chauvetia errata *spec. nov.; 33-34: holotype, 7.0 mm, Cap Rouge, Mision Gruvel (MNHN); 35: 5.7 mm, Dakar, Senegal. Figures 36.* Chauvetia megastoma *spec. nov. holotype, 7.2 mm, Mauritania (MNCN).*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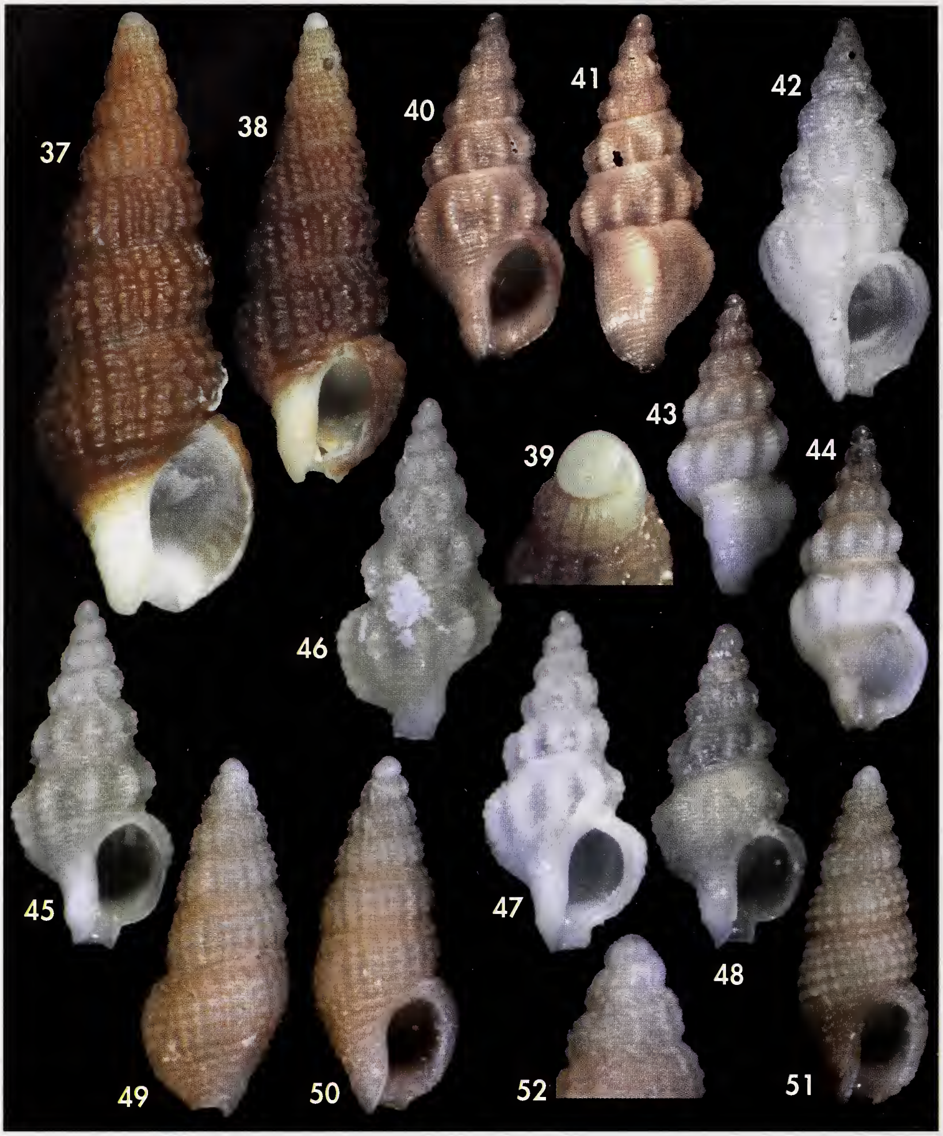
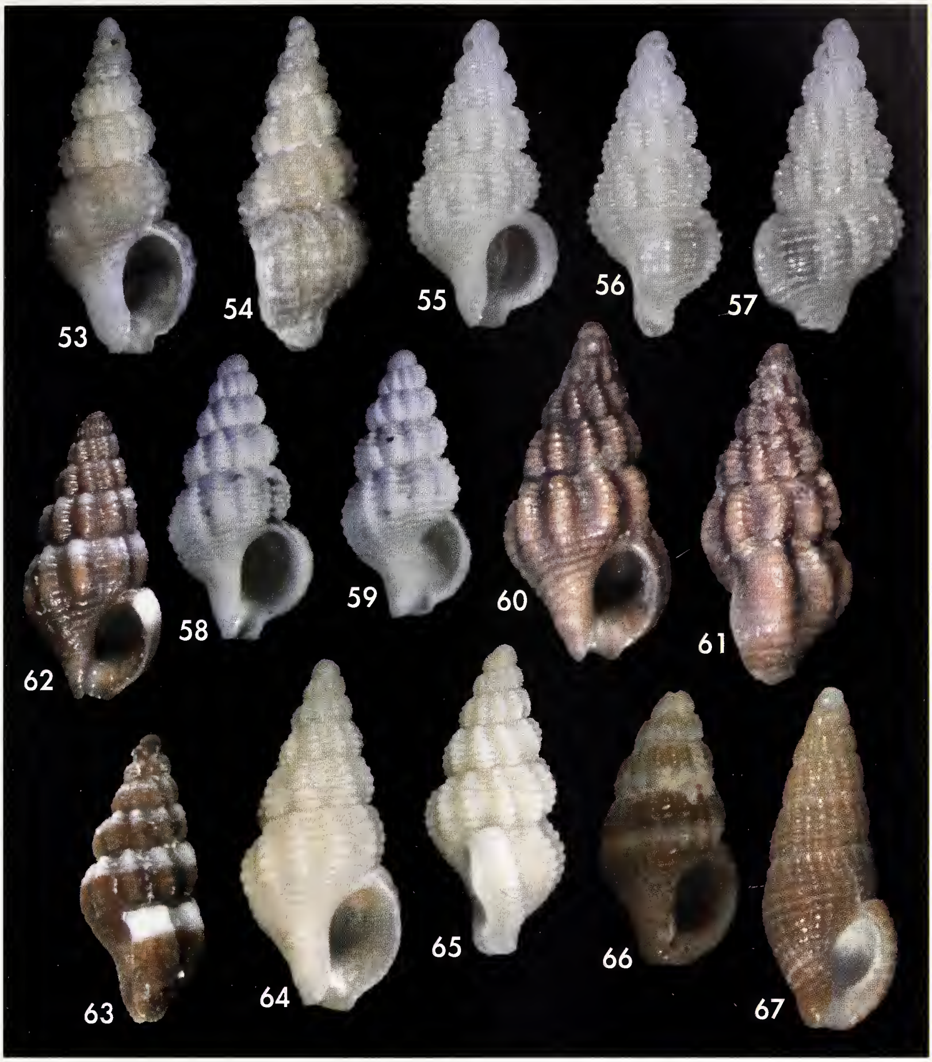


Figuras 37-39. *Chauvetia gigantissima* spec. nov., 37; paratipo, 19,7 mm (MNCN); 38: holotipo, 14,2 mm (MNHN); 39: protoconcha. Figuras 40-44. *Chauvetia hernandezi* spec. nov. 40, 41: holotipo, 8,6 mm, 22º 35' N, 16º 58' W (MNCN); 42: paratipo, 11,0 mm (MNHN); 43, 44: paratipo, 7,8 mm, (MHNS). Figuras 45-48. *Chauvetia distans* spec. nov. 45-46: holotipo, 6,8 mm, 23º 05' N, 16º 35' W, 37 m (MNCN); 47: 6,9 mm, 23º 05' N, 16º 00' W, Sahara (MNHN); 48: paratipo, 6,0 mm, 23º 05' N, 17º 05' W, 80 m (BMNH). Figuras 49-52. *Chauvetia austera* spec. nov. 49, 50: holotipo 8,4 mm (MNCN); 51: 7,8 mm, Sahara (MNHN); 52: protoconcha.

Figures 37-39. Chauvetia gigantissima *spec. nov., 37; paratype, 19.7 mm (MNCN); 38: holotype, 14.2 mm (MNHN); 39: protoconch. Figures 40-44.* Chauvetia hernandezi *spec. nov. 40, 41: holotype, 8.6 mm, 22º 35' N, 16º 58' W (MNCN); 42: paratype, 11.0 mm (MNHN); 43, 44: paratype, 7.8 mm, (MHNS). Figures 45-48.* Chauvetia distans *spec. nov. 45-46: holotype, 6.8 mm, 23º 05' N, 16º 35' W, 37 m (MNCN); 47: 6.9 mm, 23º 05' N, 16º 00' W, Sahara (MNHN); 48: paratype, 6.0 mm, 23º 05' N, 17º 05' W, 80 m (BMNH). Figures 49-52.* Chauvetia austera *spec. nov. 49, 50: holotype 8.4 mm (MNCN); 51: 7.8 mm, Sahara (MNHN); 52: protoconch.*



Figuras 53, 54. *Chauvetia peculiaris* spec. nov., holotipo, 7,7 mm, Sahara, 22º 00' N, 17º 22' W, 46 m (MNCN). Figuras 55-59. *Chauvetia edentula*, spec. nov.; 55-57: holotipo, 6,3 mm, Sahara (MNCN); 58, 59: paratipos, 5,7, 5,5 mm, Arguineguín, 377 m (CHO). Figuras 60-65. *Chauvetia borgesi* spec. nov.; 60, 61: holotipo, 7,0 mm, Gando (MNCN); 62, 63: paratipo, 6,2 mm, Gando (MNHN); 64: concha, 7,4 mm, Sahara, 22º 05' N, 16º 58' W; 65: concha, 6,5 mm, Sahara, 22º 05' N, 16º 58' W. Figura 66. *Chauvetia candidissima canarica* Nordsieck y García-Talavera, 1979, lectotipo, 5,5 mm, La Gomera (MNHC). Figura 67. *Chauvetia elongata* Nordsieck y García-Talavera, 1979, holotipo, 8,8 mm, S de Gran Canaria (MNHC).

Figures 53, 54. Chauvetia peculiaris *spec. nov., holotype, 7.7 mm, Sahara, 22º 00' N, 17º 22' W, 46 m (MNCN). Figures 55-59.* Chauvetia edentula, *spec. nov.; 55-57: holotype, 6.3 mm, Sahara (MNCN); 58, 59: paratypes, 5.7, 5.5 mm, Arguineguín, 377 m (CHO). Figures 60-65.* Chauvetia borgesi *spec. nov.; 60, 61: holotype, 7.0 mm, Gando (MNCN); 62, 63: paratype, 6.2 mm, Gando (MNHN); 64: shell, 7.4 mm, Sahara, 22º 05' N, 16º 58' W; 65: shell, 6.5 mm, Sahara, 22º 05' N, 16º 58' W. Figure 66.* Chauvetia candidissima canarica *Nordsieck and García-Talavera, 1979, lectotype, 5.5 mm, La Gomera (MNHC). Figure 67.* Chauvetia elongata *Nordsieck and García-Talavera, 1979, holotype, 8.8 mm, S of Gran Canaria (MNHC).*

Descripción: Concha (Figs. 6-13, 68-72) fusiforme, alargada con unas 6 vueltas, sólida y con sutura marcada.

Protoconcha (Figs. 73-76) con 0,8 vueltas y unos 500 μm de anchura, ornamentada por una veintena de cordones planos, de anchura parecida, y separados por interespacios de anchura similar en los que se aprecia las típicas incisiones de las *Chauvetia*. Al final de la misma aparecen cuatro o cinco costillas bastante verticales, relativamente juntas y curvadas en su parte superior donde hay una estrecha repisa.

Teleoconcha con escultura formada por cordones espirales y costillas axiales algo prosoclinas; ambos tienen una anchura similar o algo superior a sus interespacios. Primera vuelta con tres cordones espirales y el cuarto aparece enseguida, al principio como el reborde superior de la vuelta para luego separarse de la sutura. Última vuelta con cinco cordones por encima de la inserción bucal, siendo los dos superiores claramente más estrechos que el resto. El cordón superior no en todas las conchas se puede apreciar claramente siendo a veces un simple reborde poco perceptible. Por debajo de la inserción labial hay una decena más de cordoncillos que van estrechándose y aproximándose a medida que nos acercamos a la base.

Abertura con un 30% de la altura total, oval y, en el interior del labio externo, hay seis pliegues dentales de los que el más inferior marcaría el inicio del canal sifonal. Canal sifonal corto y poco claro ya que apenas se aprecia una incisión en la base del labio externo como sucede en otras especies.

Coloración: Aunque *C. affinis* presenta cierta variabilidad respecto a la forma de la concha y su escultura (puede haber conchas proporcionalmente más anchas o más alargadas, o con sus cordones más o menos anchos) las diferencias fundamentales se basan en su color. En el área de estudio hemos distinguido tres formas atendiendo a los patrones de color además de unas pocas conchas que se podrían considerar como formas intermedias.

Forma *affinis*, concha de color castaño rojizo con los tubérculos más amarillentos y redondeados.

Forma bandeada, concha blanco amarillenta con una banda marrón oscura subsutural y otra basal

Forma oscura, concha de color marrón rojizo homogénea más o menos oscura.

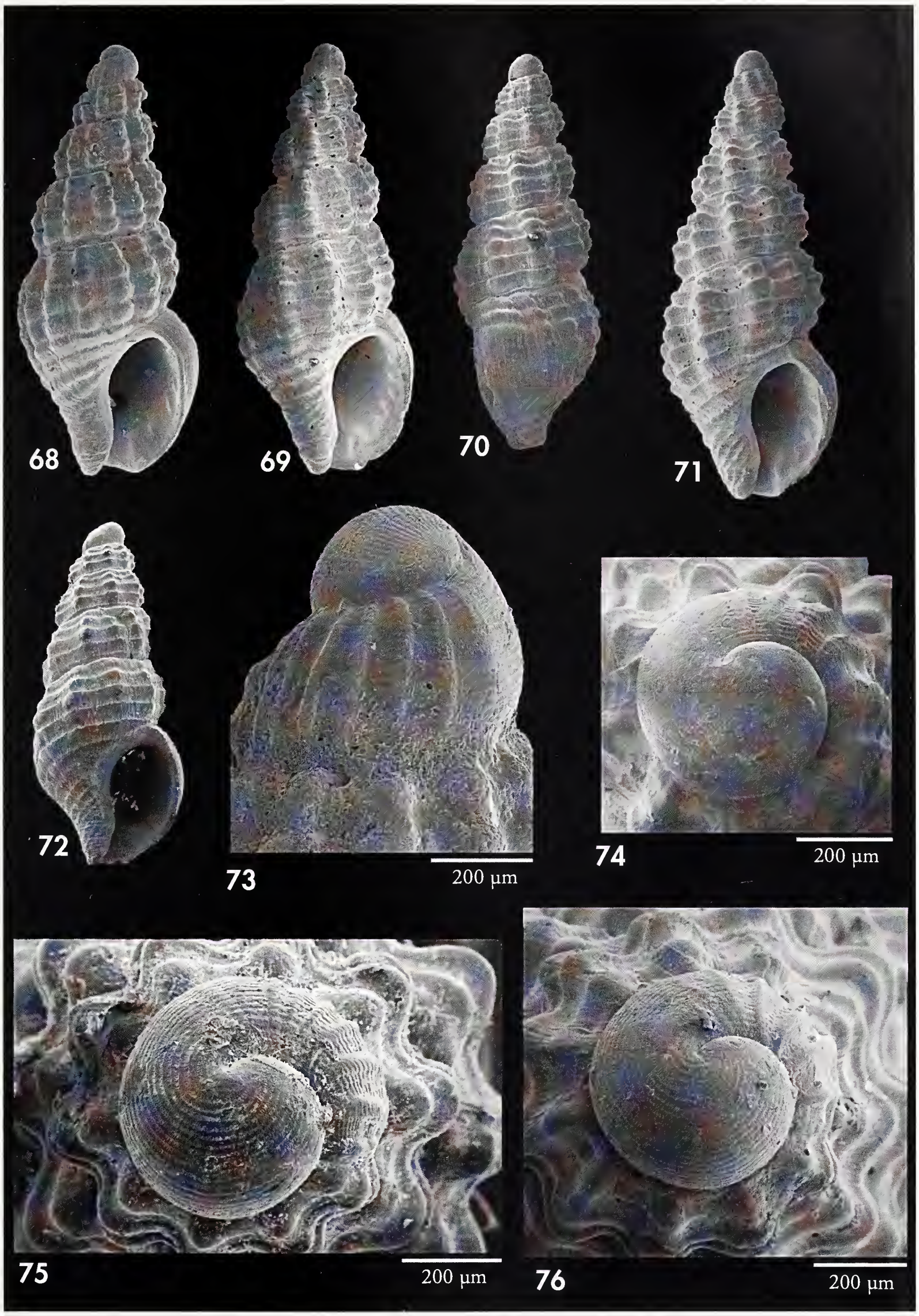
Dimensiones: hasta 5,8 mm de altura y 2,2 mm de anchura.

Distribución: Esta especie se encuentra abundantemente en Canarias, en todas sus islas. También se ha encontrado en Sahara y en el Mediterráneo.

Comentarios: La base de datos CLEMAM (en Julio 2009, cuando se remite este trabajo) considera como especies válidas *Chauvetia brunnea* (Donovan, 1804), *C. affinis* (Monterosato,1889), *C. decorata* Monterosato,1889 y *C. mamillata* (Risso, 1826) mientras que *C. turritellata* (Deshayes, 1835, *Fusus*) es considerado como un taxón dudoso que necesita una revisión.

Sin embargo, Micali (1999) considera como especies válidas *C. brunnea*, *C. turritellata* y *C. mamillata* mientras que los taxones *Donovania affinis* Monterosato, 1889 y *Chauvetia decorata* Monterosato, 1889 son considerados variedades de *C. turritellata* y por lo tanto sinónimos.

Según Micali (1999), *C. mamillata* se diferencia de las otras dos por su mayor tamaño (7 mm frente a 5 mm de *C. turritellata* y *C. brunnea*), entre otras características. Por su parte, *C. turritellata* se distinguiría de *C. brunnea* por tener una forma más ahusada, un mayor número de costillas axiales (de diez a quince en la última vuelta frente a diez en *C. brunnea*), denticulación en el labio interno menos acentuada, escultura menos relevante y costillas más sutiles. En este estudio consideramos *C. affinis* el nombre válido y no utilizamos el nombre de *C. turritellata* por tener esta su localidad tipo en el Mediterráneo oriental. Se ha intentado localizar el material tipo de *Fusus turritellatus* Deshayes, 1835 pero no se ha encontrado en el MNHN, y tampoco en la Ecole de Mines de Paris (Virginie Heros, pers. com.); tampoco está en BMNH (Amelia MacLellan, pers. com.). Siendo estas las



Figuras 68-76. *Chauvetia affinis* (Monterosato, 1889): 68, 70, 73, 76: 5,1, 4,8 mm, forma affinis y protoconchas, Tarajalillo, Gran Canaria; 69, 74: 5,2 mm, forma oscura, Las Burras, Gran Canaria; 71: 5,8 mm, forma bandeada, Tenerife; 72, 75: 4,0 mm, Orzola, Lanzarote.

Figures 68-76. Chauvetia affinis *(Monterosato, 1889): 68, 70, 73, 76: 5.1, 4.8 mm, form* affinis, *and protoconchs, Tarajalillo, Gran Canaria; 69, 74: 5.2 mm, dark form , Las Burras, Gran Canaria; 71: 5.8 mm, banded form , Tenerife; 72, 75: 4.0 mm, Orzola, Lanzarote.*

instituciones que, según DANCE (1986), podrían contener el material de Deshayes, se puede considerar perdido. A efectos taxonómicos, pensamos que este taxon no debe estar representado en el área de estudio dado su origen en el Mediterraneo oriental y su ausencia en el estrecho de Gibraltar, sur de España y norte de Marruecos. Por otra parte también discrepamos con Micali en considerar *C. decorata* como sinónima de *C. turritellata*. Creeemos que *C. decorata* es una especie con entidad propia que se abordará en trabajos posteriores.

Los cuatro taxones reseñados anteriormente junto con *C. tenebrosa* Oliver y Rolán, 2008, una especie de Senegal, pertenecen a un grupo de *Chauvetia* muy parecidas y sin duda emparentadas filogenéticamente. Determinar qué especies son válidas y qué son variedades o dónde empieza una especie y dónde acaba otra es complicado y, en todo caso, un estudio fundamentalmente conquiológico no puede resolver definitivamente el problema. La dificultad se ve acrecentada por la amplia distribución de estas especies que, por otra parte, presentan una protoconcha paucispiral, posiblemente con desarrollo lecitotrófico y con posibilidades de dispersión limitada, lo que favorecería la especiación, fundamentalmente en ambientes insulares. Algo de esto se ha podido comprobar en conchas del Banco Gorringe y de Lanzarote que se estudiarán y se mencionarán en un próximo trabajo.

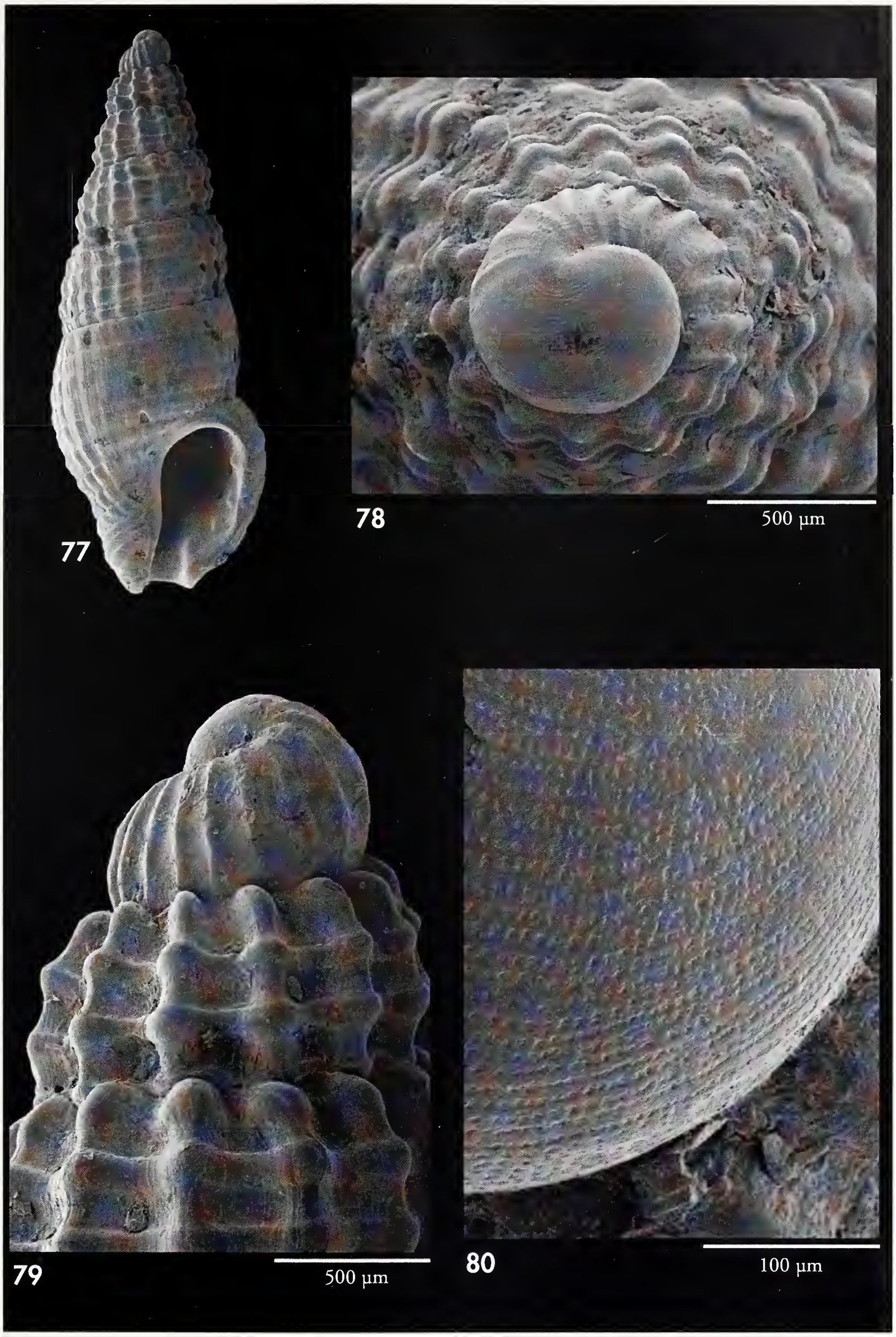
Respecto a las diferencias en la coloración de las partes blandas, MIFSUD (1994) indica que *C. turritellata* presenta un pie blanco opaco con la cabeza, los tentáculos y el sifón negro grisáceo. Para apoyarlo aporta fotos de ejemplares italianos (Acitrezza). Esto contrastaría con la descripción del animal de *C. brunnea* dado por FRETTER Y GRAHAM (1984) que indican que el animal sería de color crema con puntos opacos blancos. Por su parte, *C. mamillata* es de color negro azulado (HERGUETA, LUQUE Y TEMPLADO 2002 y observación personal). El animal de *C. affinis* es de color grisáceo con el pie de color blanco. Este color se presenta tanto en la forma bandeada como en la forma típica *affinis* (Figs. 162 y 163). En el caso de *C. turritellata* del Mediterráneo, el color grisáceo del cuerpo del animal se da en forma de manchas irregulares (MICALI, 1999: figs. 24-26) y no de forma continua como es el caso de *C. affinis*. En el presente trabajo se ilustra (Figs 160-161) también un animal de color claro, casi traslúcido, con alguna mancha opaca de color blanco leche cuya concha seguiría el patrón *affinis*. Dado el reducido número de animales estudiados no podemos asegurar si existe variabilidad en el color del animal o por el contrario si nos encontramos ante dos especies crípticas. Por ello se ha optado por considerar a esta última como *C.* cf. *affinis*.

El estudio y comparación de estos taxones con otras especies mediterráneas, del Atlántico europeo y del área del Estrecho, se hará en la revisión de las especies mediterráneas y atlánticas europeas que actualmente se está realizando.

Chauvetia lefebvrii (Maravigna,1840) (Figs. 14-16, 77-80)

Fussus granulatus Calcara, 1839 non *Nassaea granulata* Risso, 1826.
Buccinum lefebvrii Maravigna, 1840.
Buccinum folinae sensu Philippi, 1844 non Delle Chiaje, 1828.
Lachesis areolata Tiberi, 1868.
Murex folineae sensu Philippi, 1844 non Delle Chiaje, 1828.
¿*Chauvetia obliqua* Nordsiek y Talavera, 1979: 141.
Chauvetia pellisphocae sensu Nordsieck, 1976 non Reeve, 1845.

Material tipo: Desconocido.
Material estudiado: SAHARA: 1 j, 23° 10′ N, 16° 28′ W, (CHO); 2 c, 22° 35′ N, 16° 58′ W, 58 m (CHO); 1 c, 22° 35′ N, 16° 58′ W, (CHO); 13 ej, lote 304 (CHO); 10 ej, 23° 05′ N, 17° 00′ W, 40 m, (CHO); 1 ej, Cabo Barbas, 58 m (CHO); 2 c, 23° 05′ N, 17° 00′ W (CFS); 6 c, Barcos de Pesca (MHNS); 2 c, 50-60 m (CPR).



Figuras 77-80. *Chauvetia lefebvrii* (Maravigna, 1840); 77: concha, 8,4 mm, Sahara Occidental; 78, 79: protoconcha, Sahara Occidental; 80: microescultura de la protoconcha.
Figures 77-80. Chauvetia lefebvrii *(Maravigna, 1840); 77: shell, 8.4 mm, West Sahara; 78, 79: protoconch, West Sahara; 80: microsculpture of the protoconch.*

Descripción: Concha (Figs. 14-16) fusiforme-alargada, sólida, con unas seis vueltas de espira, sutura poco marcada.

Protoconcha (Figs. 78, 79) con 0,8 vueltas, y una anchura de unas 850 μm (núcleo: 500 μm, primera media vuelta: 680 μm) y unas 700 μm de altura. Escultura espiral (Fig. 80) poco marcada (muy difícil de apreciar en ejemplares algo rodados) formada por unos treinta o cuarenta cordones separados por interespacios de anchura similar y en los que se aprecian las incisiones típicas de las *Chauvetia*. A partir de la primera media vuelta de la protoconcha aparecen una decena de costillas separadas por espacios en los que se ven los cordones espirales. La parte superior de las costillas está curvada y forma, en la parte superior de la protoconcha, un estrecho canal. El final de la protoconcha es poco claro por lo que se ha considerado como tal el momento en que van apareciendo los cordones espirales de la teleoconcha.

Teleoconcha con vueltas de perfil planoconvexo y sutura poco profunda. Escultura formada por cordones espirales, con anchura similar a sus interespacios, lo que ocurre también en las costillas. Ambos son en general poco relevantes siendo más evidentes en las primeras vueltas. En el inicio de la teleoconcha aparecen tres cordones espirales, formando el superior el reborde de la espira. En la tercera vuelta aparece por encima un cuarto cordón en principio más estrecho que los inferiores. En la penúltima vuelta puede observarse ocasionalmente un quinto cordón inferior prácticamente oculto por la sutura. En la última vuelta, por encima de la inserción labial, hay cuatro cordones planos, por lo general más anchos que sus interespacios. En la base hay aproximadamente una decena más de cordones que se van juntando en el canal sifonal. En la última vuelta apenas se perciben las costillas (unas veinte, algo prosoclinas) que llegan hasta la base de la concha acabando cerca del inicio del canal sifonal.

Abertura oval ocupa cerca del 27 % de la altura total. Labio externo varicoso con 4 dientes en su parte interna. Canal sifonal poco desarrollado.

Coloración de la concha: los cordones espirales son marrón rojizo sobre un fondo blanco amarillento. Dependiendo de la anchura de los cordones la concha resulta más o menos oscura. En algunos ejemplares se ha podido observar la típica coloración "nodulada", aunque débil y sobre todo en las vueltas iniciales. Esta coloración, típica de las conchas mediterráneas, se debe a que los cordones son más claros, incluso amarillentos, en los espacios intercostales. El interior de la concha es blanco.

Dimensiones: hasta una altura máxima de unos 9 mm.

Animal: desconocido.

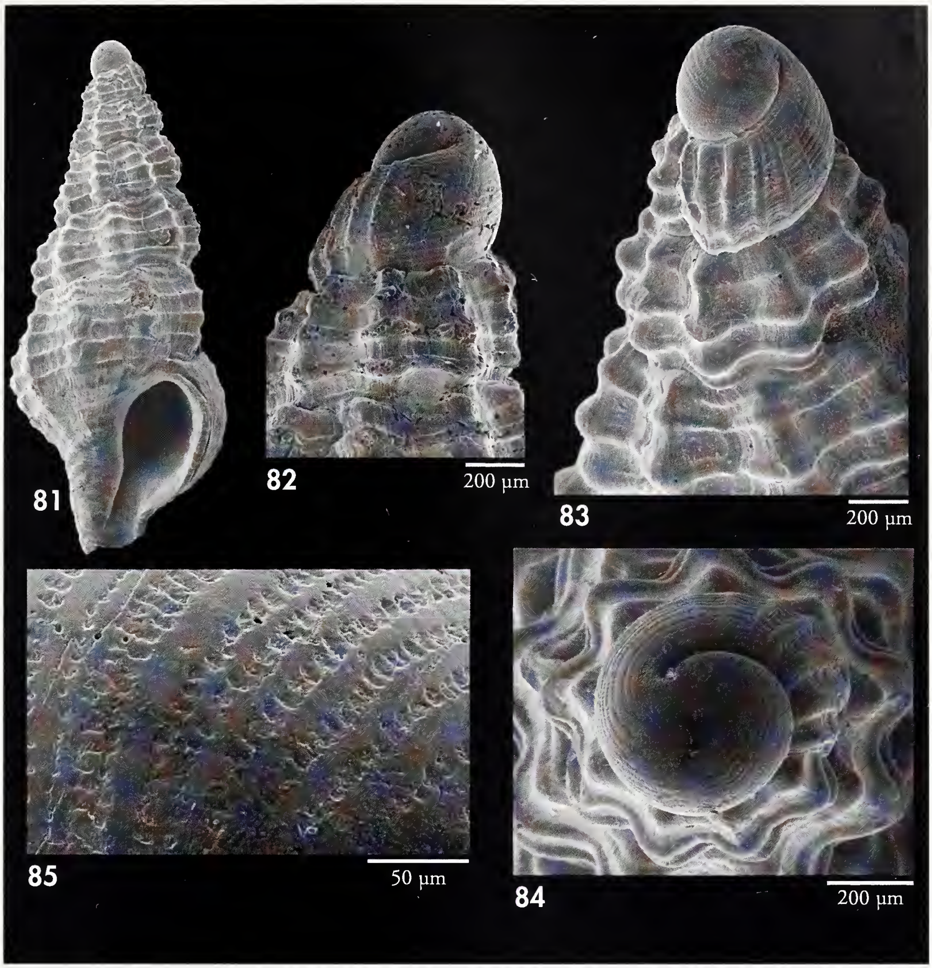
Distribución: La especie se halla presente desde el Mediterráneo y costa occidental de la Península Ibérica, hasta el Sahara, pero no se ha encontrado en Canarias.

Comentarios: Las conchas del Sahara tienen un patrón de color lineado y parecen ser la forma más meridional de una especie algo variable. La forma mediterránea es más pupoide y de aspecto noduloso. En el área del Estrecho de Gibraltar se presentan tanto formas lineadas como nodulosas. El aspecto de la protoconcha y de las primeras vueltas es similar en todas, lo que parece indicar que se trata de una única especie.

Chauvetia procerula (Monterosato 1889) (Figs. 17, 18, 81-85)

Donovania procerula Monterosato 1889. *Journ. de Conch.*, 37: 116. [Localidad tipo: Marruecos, Casablanca (Ponsonby), Argelia (Joly)].
Chauvetia vulpecula Nordsieck y García-Talavera, 1979 non *Lachesis vulpecula* Monterosato, 1872.

Material tipo: Supuestamente en el ZMR. No examinado.
Otro material estudiado: CANARIAS: Gran Canaria: 3 c, 2 j, Arguineguín, (CHO); 2 c, Arguineguín, 150-180m (CHO); 1 c, TA007, frente a Sardina (CHO); 2 j, Tal01 (CHO); 1 c, Ar301 (CHO). Fuerteventura: 1 c, 7 j, 100 m (CFS); 1 j, Playa Blanca, 70 m (CFS). Lanzarote: 9 j, Boccaina, Isla Graciosa (CFS).



Figuras 81-85. *Chauvetia procerula* (Monterosato 1889); 81: concha, 4,7 mm, Arinaga, Gran Canaria; 82-84: protoconcha; 85: microescultura de la protoconcha.
Figures 81-85. Chauvetia procerula *(Monterosato 1889); 81: shell, 4.7 mm, Arinaga, Gran Canaria; 82-84: protoconch; 85: microsculpture of the protoconch.*

Descripción: Concha (Figs. 17, 18, 81) sólida, de perfil cónico algo ahusado con vueltas algo convexas, sutura no demasiado profunda y algo ondulada y con unas 6 vueltas.

Protoconcha (Figs. 82-84) con aproximadamente una vuelta, una anchura de unas 580 μm (núcleo: 220 μm, primera media vuelta: 320 μm) y unas 600 μm de altura. Parte inicial globular, algo aguda. Escultura (Fig. 85) formada por una docena de cordoncillos espirales algo más anchos que sus interespacios, en los que aparecen las típicas incisiones características de muchas *Chauvetia*. En el tramo final de la protoconcha aparecen unas pequeñas costillas que van aumentando de relevancia a medida que se aproxima al inicio de la teleoconcha. Las costillas están curvadas superiormente, delimitando un estrecho canal en la parte superior de la protoconcha.

Teleoconcha con unas 5 vueltas, la última ocupa cerca del 55 % de la altura to-

tal. Escultura constituida por costillas axiales ortoclinas o ligeramente prosoclinas, fuertes, prominentes y algo más estrechas que sus interespacios. Cordones espirales menos salientes que las costillas y al cruzarse con ellas forman nódulos redondeados. Son tan anchos como sus interespacios. En la primera vuelta hay cuatro cordones siendo el superior el reborde inferior de la sutura. En la última espira hay nueve o diez costillas y trece o catorce cordones espirales. De estos, hay cinco por encima de la inserción labial, los dos superiores más estrechos, y un sexto a la altura de la misma inserción.

Abertura que representa el 37% de la altura de la concha y en el interior se pueden apreciar cinco o seis dientes, siendo el inferior quien marca el inicio del canal sifonal. Canal sifonal corto pero evidente debido a la presencia de una escotadura clara en la base del labio externo y que caracteriza a la especie.

Coloración amarillenta. Algunas conchas son blancas con los interespacios de los cordones y la base rojiza.

Dimensiones: alcanza una altura de hasta 6,7 mm y unos 2,8 mm de anchura.

Distribución: La especie está presente desde Canarias hasta el Mediterráneo.

Comentarios: Las conchas estudiadas no presentan diferencias significativas con las del Mediterráneo a pesar de mostrar en su conjunto una cierta variabilidad.

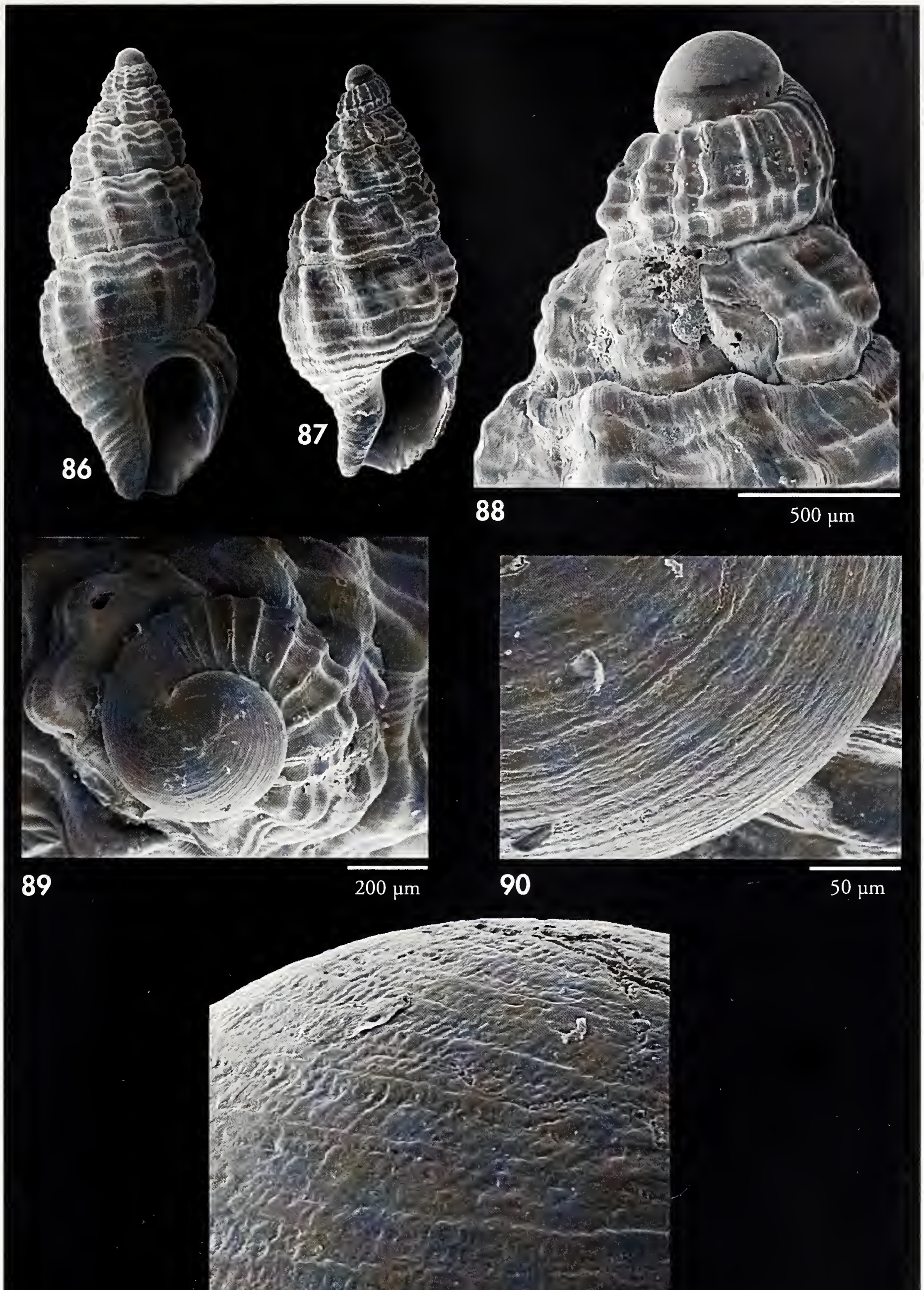
Chauvetia crassior (Odhner, 1932) (Figs. 19-24, 86-91)

Sintagma crassior Odhner, 1932: 20, lám. 1, fig. 5. [La Luz, Gran Canaria, Islas Canarias, 100 m].
Chauvetia obliqua Nordsieck y García-Talavera, 1979: 141, lám. 33, fig. 3.

Material tipo: Holotipo (MNHN) no examinado, aunque fotografiado (Figs. 19, 20).
Otro material estudiado: CANARIAS: Gran Canaria: 10 c, 5 j, El Cabrón (CFS); 12 j, NO Gran Canaria (CFS); 1 c, Arinaga, NO Gran Canaria (CHO); 2 c, 1 j, Sardina, NO Gran Canaria, 15 m (CHO); 1 c, Sardina, 15 m (CFS); 1 ej, Sardina, 58 m (CHO); 2 c, Sur de Gran Canaria, 35 m (CHO); 2 c, Dos Roques (CHO); 2 c, Gando, 8 m (CHO); 1 c, Gando 8/15/83 (CHO); 6 c, C0002 (CHO); 1 j, Gran Canaria 28/02/02, 70 m (CHO); 2 j, RH020 (CHO); 35 ej y c, Punta del Tostón 28º 46′ N, 13º 59′ W, 400 m (CFS). Fuerteventura: 3 c, off la Entallada, 81-85 m (CHO); 3 c, C0012; 1 c, C0001 (CHO); 2 c, CL030 (CHO); 1 c, CFV065 (CHO); 1 c, AR301 (CHO); 1 c, RHI/3008, 85 m (CHO); 1 c, FH17 (CHO); 1 j, El Cabrón (CHO); 2 j, 1 f, AR016 (CHO); 2 ej, lote 307, C0005b (CHO); 1 c, lote 226, LTF 050 Candelaria, 80 m (CHO); 1 j, Ar001, lote 259 (CHO); 1 e, lote 308, C0005B (CHO). Lanzarote: 1 c, Playa Reducto, Arrecife (CFS); 1 j, Pto. Carmen, 27 m (CHO); 5 c, Puerto del Carmen (CFS); 5 c, Playa Honda, Pta Matagorda (CHO). Tenerife: 2 c, 60 m (CFS); 3 c, lote17901 (MHNS); 3 c, lote14781 (MHNS); 3 c, 2 j, Muellito del Faro, 15 m (CPB); 1 j, Cueva de las Corvinas, 28 m (CPB); 5 c, Cueva de las Corvinas, 28 m (CPB); 2 c, Muellito del Faro, 3-12 m, (CPB); 1 j, Diente de Ajo, 0-25 m (CPB); 1 c, 1 j, Ballenita (CPB); 3 c, Ballenita, 12 m (CPB); 6 c, 4 j, Muellito del Faro 10-18 m (CPB); 1 j, en la bahía Muellito del Faro 8-12 m (CPB); 3 j, 4 ej, Arco, 18 m (CPB). SAHARA: 1 c, 22º 35′ N, 16º 58′ W (CHO); 2 ej, 23º 05′ 35″N, 16º 25′ 00″W (CHO). MAURITANIA: 1 c, Cabo Blanco, 80 m (CFS).

Descripción: Concha (Figs. 19-24, 86, 87) fusiforme, sólida, con unas seis vueltas de espira y aspecto tosco. Protoconcha (Figs. 88, 89) con una vuelta, y con una anchura de unos 630 μm (núcleo: 330 μm, primera media vuelta: 500 μm) y unas 600 μm de altura. Escultura espiral (Figs. 90, 91) formada por cordoncillos estrechos de anchura desigual, poco definidos así como sus interespacios. Escultura axial formada por unas cinco o seis costillas que aparecen en el tramo final de la protoconcha y que se van ensanchando progresivamente. La transición con la teleoconcha es difícil de apreciar y se ha considerado que ocurre cuando aparecen los cordones de ésta.

Teleoconcha con una escultura de cordones espirales de anchura mayor que sus interespacios. Las costillas, algo sigmoideas, son prosoclinas y de anchura similar o algo más estrechas que los interespacios. En el inicio de la teleoconcha aparecen cuatro cordones espirales



Figuras 86-91. *Chauvetia crassior* (Odhner, 1932); 86, 87: conchas, 6,4, 5,4 mm, Playa Honda, Punta Matagorda, Lanzarote; 88, 89: protoconcha; 90, 91: microescultura de la protoconcha.
Figures 86-91. Chauvetia crassior *(Odhner, 1932); 86, 87: shells, 6.4, 5.4 mm, Playa Honda, Punta Matagorda, Lanzarote; 88, 89: protoconch; 90, 91: microsculpture of the protoconch.*

siendo el superior el reborde de la espira. En la última vuelta hay cinco cordones por encima de la inserción labial de los que los dos superiores son de menor anchura siendo el superior el reborde de la sutura. Los tres inferiores son de anchura similar y son planos y con poco resalte. Hacia la base, aparecen una docena de cordoncillos más. La escultura axial de la última vuelta está formada por una decena de costillas que apenas se prolongan por debajo de la inserción labial. Esta vuelta ocupa el 58 % de la altura total de la concha.

Abertura oval, algo más rectilínea en su parte externa, y que alcanza el 39% de la altura de la concha. En el interior del labio externo se aprecian cinco o seis dientes, constituyendo el inferior el borde externo del canal sifonal, que es muy corto y bastante abierto.

Coloración: el color de la concha puede ser castaño rojizo uniforme con el interior blanco o amarillenta con una banda rojiza subsutural y otra en la base de la concha o sólo en la base de la concha. Algunas conchas son marrón oscuro, aunque puede aparecer una banda blanca subsutural que afecta a los dos o tres cordones espirales superiores.

Dimensiones: las conchas tienen una altura máxima de hasta 8,8 mm.

Animal (Figs. 156, 157): Color crema-amarillento con puntos blanquecinos; sifón del mismo color.

Distribución: La especie ha sido citada en las costas del sur de la Península Ibérica (MICALI, 1999), y está representada en nuestro material del Sahara, Canarias y en menor cantidad en Mauritania.

Comentarios: Los pocos ejemplares estudiados procedentes de la costas del Sahara son más rechonchos con la boca menos cuadrada que los de Canarias. ODHNER (1932) describió la especie para Canarias y el holotipo es similar a las conchas estudiadas del archipiélago. Por ese motivo, a la forma de Sahara y Mauritania se la ha considerado provisionalmente como *C.* cf. *crassior* a la espera de profundizar en su estudio.

La especie se puede confundir con *C. borgesi* nov spec. (ver comentarios de esta última).

Chauvetia obliqua Nordsieck y García-Talavera, 1979, aparece en la descripción original con unas dimensiones de 6 x 3 mm. La localidad tipo es Porto Santo. En el MNHC nos indican que el tipo ha sido prestado y no está disponible. Pero en el material del MNHC hay otra concha muy similar, con el mismo color y dimensiones y las costillas prosoclinas, siendo también procedente de Porto Santo. En cualquier caso, falta totalmente la protoconcha y la morfología de la concha está dentro de la variabilidad típica de *Chauvetia crassior*.

Chauvetia lamyi Knudsen, 1956 (Figs. 25, 26)

Chauvetia lamyi Knudsen, 1956. *Atlantide Report*, 4: 43, lám. 3, figs. 17, 18. [Localidad tipo: "Atlantide" St. 56, frente a Liberia, 6°01'N, 10°26'W, 50 m]

Material tipo: No examinado. Supuestamente en ZMUC.
Material estudiado: SAHARA: 2 c, 22° 55' N 16° 05' W (CHO); 1 c, lote 251 23° 08' N, 16° 26' W (CHO); 1 c, 1 j, 23° 05' N, 16° 28' W, 29 m (CHO); 1 c, lote 199 (CHO); 1 c, lote244, 23° 05' N, 17° 00' W (CHO); 1 ej, Peña Grande, 25° 45' N, 15° 25' W, 20 m (CHO). MAURITANIA: Baie de l' Étoile: 1 c, intermareal (CHO).

Descripción: Ver OLIVER Y ROLÁN (2008).

Distribución: Costa oesteafricana, desde Costa de Marfil por el sur estando el límite norte de la especie en el Sahara.

Comentarios: Como se comenta en OLIVER Y ROLÁN (2008) el taxon podría incluir varias especies crípticas. Las conchas estudiadas en el presente trabajo no muestran diferencias significativas que indiquen que pueda tratarse de una especie distinta a la de Senegal.

Chauvetia javieri Oliver y Rolán, 2008 (Figs. 27-30, 92-99)

Chauvetia javieri Oliver y Rolán, 2008. *Iberus*, 26(2): 162, figs. 45-48, 74, 144-151. [Cap Vert, pecio del "Tacoma", Bahía de Dakar, Senegal, 30 m].

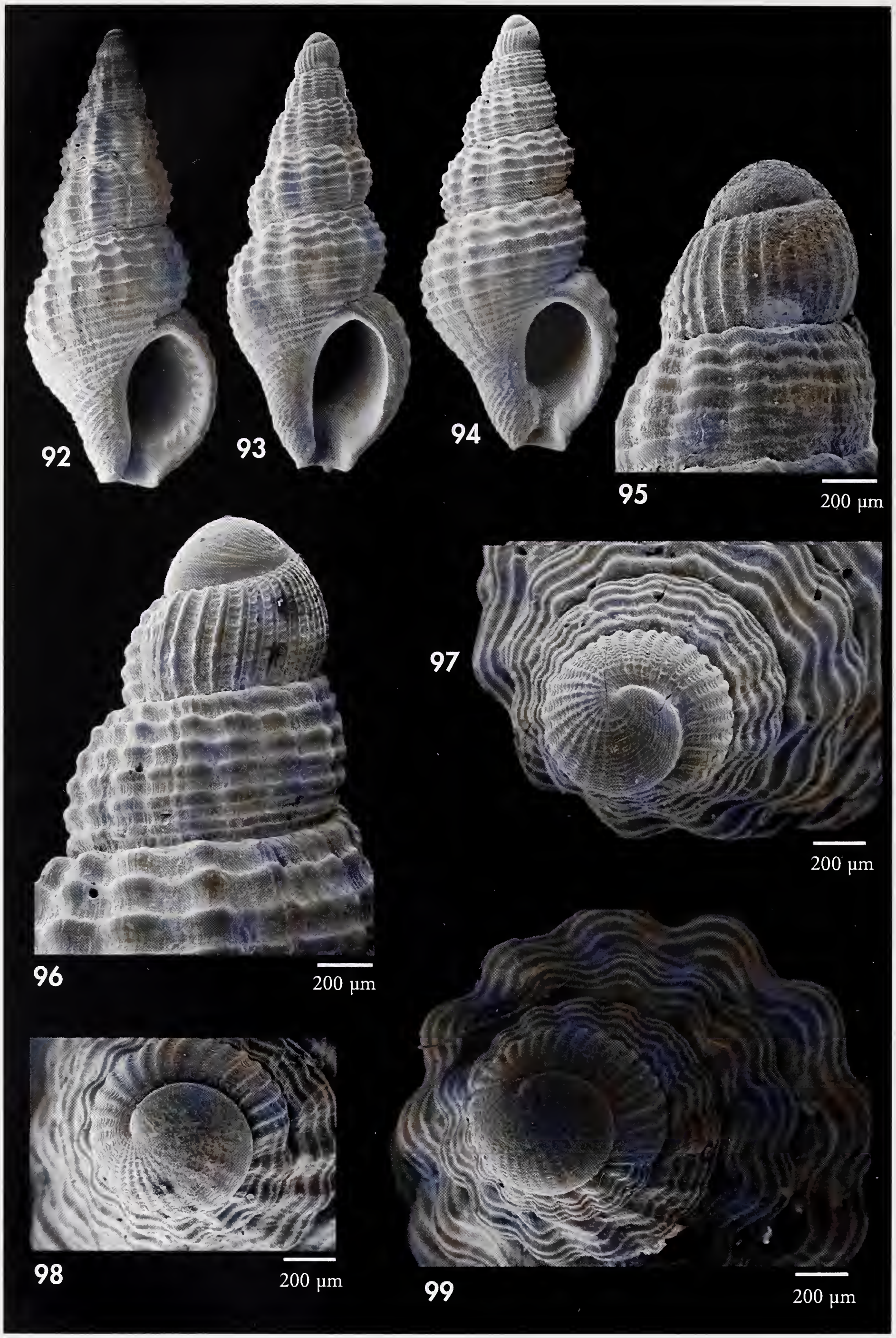
Material tipo: Holotipo en MNCN (15.05/47529). Paratipos: 54 en varias colecciones (ver OLIVER Y ROLÁN, 2008).
Otro material estudiado: SAHARA: 17 c, West Sahara, lote 292, 22° 35′ N, 16° 58′ W, 58 m (CHO); 1 c, lote 264, M15, 22° 00′ N, 17° 22′ W (CHO); 6 c, 23° 05′ N, 16° 28′ W, 84 m (CHO); 3 c, lote 299, M13, 23° 05′ N, 17° 00′ W (CHO); 1 c, lote 293, 22° 35′ N, 18° 58′ W, 58 m, (CHO); 1 c, lote 286, 22° 00′ N, 17° 22′ W (CHO); 8 c, lote 287, Sur Peña Grande, 24° 45′ N, 15° 25′ W, 32 m (CHO); 4 c, lote 206, 23° 08′ N, 16° 25′ W (CHO); 1 c, lote 265, 22° 05′ N, 17° 11′ W (CHO); 3 c, lote 267, 24° 28′ N, 15° 51′ W (CHO); 1 c, lote 279, 23° 05′ N, 16° 27′ W (CHO); 4 c, lote 260, 23° 05′ N, 16° 28′ W (CHO); 1 c, lote 252, Sur Peña Grande, 24° 45′ N, 15° 25′ W, 32 m (CHO); 4 c, lote 282, 23° 05′ N, 16° 28′ W (CHO); 4 c, lote 278, 23° 05′ N, 16° 28′ W (CHO); 1 c, lote 285, 22° 00′ N, 17° 22′ W (CHO); 4 c, lote 261, 22° 55′ N, 16° 36′ W (CHO); 1 c, lote 273, 22° 05′ N, 17° 11′ W (CHO); 1 c, lote 277, 22° 00′ N, 16° 35′ W (CHO); 1 c, lote 274, 22° 34′ N, 16° 58′ W (CHO); 1 ej, lote 269, 24° 32′ N, 15° 51′ W (CHO); 1 c, lote 272, 22° 05′ N, 17° 11′ W (CHO); 1 ej, lote 217, 22° 51′ N, 17° 11′ W (CHO); 8 c, 22° 35′ N, 16° 58′ W, 58 m, (CHO); 1 c, lote 214, 22° 55′ N, 16° 35′ W (CHO); 2 j, lote 289, 24° 45′ N, 15° 25′ W (CHO); 2 c, 20° 15′ N, 16° 41′ W (CHO); 1 c, lote 207, 23° 08′ N, 16° 25′ W (CHO); 2 c, lote 211, 23° 15′ N, 16° 40′ W (CHO); 1 c, lote 221, 22° 17′ N, 17° 22′ W (CHO); 1 c, lote 203, 22° 35′ N, 16° 58′ W (CHO); 1 c, 22° 05′ N, 17° 11′ W, 84 m (CHO); 2 c, M/8-9, 23° 05′ N, 11° 20′ W (CHO); 1 c, lote 235, 23° 08′ N, 16° 20′ W (CHO); 1 c, lote 243 22° 05′ N, 17° 11′ W (CHO); 1 c, 23° 05′ N, 16° 28′ W, 30 m (CHO); 1 ej, lote 245, 23° 05′ N, 16° 27′ W (CHO); 1 c, 22° 00′ N, 17° 22′ W, 84 m (CHO); 1 c, lote 234, 25° 25′ N, 15° 02′ W (CHO); 1 c, 22° 17′ N, 17° 22′ W, 84 m (CHO); 1 c, Cape Barba, 58 m, 22° 35′ N, 16° 58′ W, (CHO); 1 ej, lote 258, 22° 35′ N, 16° 25′ W, I15f, (CHO); 45 ej, varias etiquetas de localización (CHO); 6 ej, lote 257, 24° 45′ N, 15° 25′ W, 20 m, Peña Grande (CHO); 7 ej, 23° 05′ N, 17° 00′ W, 40 m (CHO); 37 ej, varias etiquetas de localización (2) 36 m (CHO); 2 ej, 25° 45′ N, 15° 25′ W, 36 m, Peña Grande (CHO); 1 ej, lote 226, 25° 51′ N, 15° 02′ W (CHO); 2 c, (CPR); 20 c, barcos de pesca (MHNS). MAURITANIA: 2 c, lote 224, MM0004 (CHO); 5 c, material de barcos de pesca (MHNS).

Descripción: Concha (ver OLIVER Y ROLÁN, 2008). Representada en este trabajo (Figs. 21, 22, 92-94). Protoconchas (Figs. 95-99).

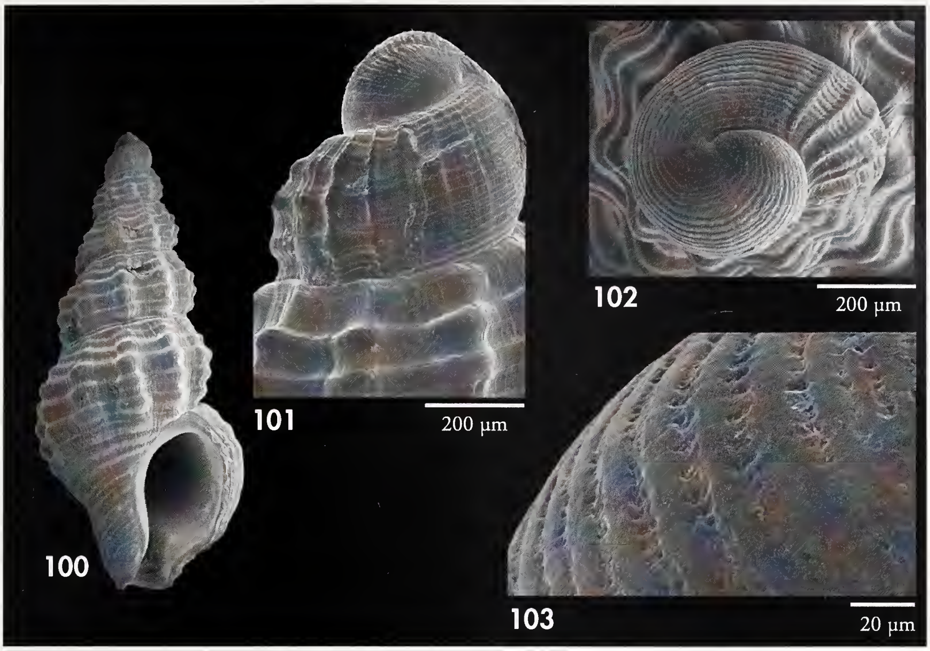
Distribución: Conocida de Senegal, Mauritania y Sahara.

Comentarios: Durante el tiempo en el que el trabajo de descripción de esta especie fue publicado, ARDOVINI (2008) describió una especie de Senegal con el nombre de *C. bartolomeoi*. Este trabajo carece de fotografías al microscopio electrónico y de los detalles finos de la escultura; hace comparación de la especie con sólo otras dos diferentes y, aunque menciona que debe compararse con una tercera, esta comparación no aparece en el texto. Además, no se señala holotipo, aunque se presenta una imagen; no se dan sus dimensiones, ni se deposita en museo alguno. Algunos de estos datos aparecen en un trabajo anónimo en un número posterior fechado en Octubre de 2008, pero que fue recibido mucho tiempo después. Por todo ello, nosotros seguimos considerando como válido el nombre de *C. javieri*.

Las conchas de *C. javieri* de Sahara presentan algunas diferencias con respecto a las del Sahara. La abertura bucal no es tan prominente y sus costillas y sus cordones suelen ser tan anchos como sus interespacios mientras que en la de Senegal suelen ser más anchos. En cuanto al número de cordones por encima de la inserción labial y a su protoconcha no se han comprobado diferencias significativas, aunque se ha observado en las conchas del Sahara cierta variabilidad. Por otra parte, las conchas de *C. javieri* de esta zona suelen ser de color castaño rojizo mientras que las de Senegal son amarillentas con una franja rojiza en la base. No obstante también se han estudiado algunas conchas con esta última tonalidad así como otras de color totalmente blanco.



Figuras 92-99. *Chauvetia javieri* Oliver y Rolán, 2008; 92-94: conchas, 7,8, 6,5, 7,0 mm, Sahara; 95-99: protoconchas.
Figures 92-99. Chauvetia javieri *Oliver and Rolán, 2008; 92-94: shells, 7.8, 6.5, 7.0 mm, Sahara; 95-99: protoconchs.*



Figuras 100-103. *Chauvetia tenebrosa* Oliver y Rolán, 2008; 100: concha, 3,6 mm, Nouadhibou, Mauritania; 101, 102: protoconcha; 103: microescultura de la protoconcha.
Figures 100-103. Chauvetia tenebrosa *Oliver and Rolán, 2008; 100: shell, 3.6 mm, Nouadhibou, Mauritania; 101, 102: protoconch; 103: microsculpture of the protoconch.*

Chauvetia joani Oliver y Rolán, 2008 (Fig. 31)

Chauvetia joani Oliver y Rolán, 2008. *Iberus*, 26(2): 164, figs. 49-52, 75, 152-159, 188. [Cap Vert, "Tacoma", Bahía de Dakar, Senegal, 13 m].

Material tipo: Holotipo en MNCN (15.05/47530). Paratipos: 16 en varias colecciones (ver OLIVER Y ROLÁN, 2008).
Otro material estudiado: MAURITANIA: 2 c, 2 j, Baie de l' Étoile (MHNS).

Descripción: Concha y protoconcha (ver OLIVER Y ROLÁN, 2008).

Distribución: Conocida previamente de Senegal, su área de distribución se ha encontrado ahora ampliada hasta Mauritania, aunque aquí se ha encontrado en escasa cantidad.

Comentarios: No hay diferencias con el material ahora estudiado y el material tipo.

Chauvetia tenebrosa Oliver y Rolán, 2008 (Figs. 32, 100-103)

Chauvetia tenebrosa Oliver y Rolán, 2008. *Iberus*, 26(2): 148, figs. 7-9, 67, 114-120. [Pecio del "Tacoma", Dakar, Senegal, entre 20 y 30 m].

Material tipo: Holotipo en MNCN (15.05/47536). Paratipos: 212 en diferentes colecciones (ver OLIVER Y ROLÁN, 2008).
Otro material estudiado: MAURITANIA: 17 c, 5 j, Baie de l' Étoile, Nouadibou (CHO).

Descripción: Concha: Ver OLIVER Y ROLÁN, 2008 (Figs. 32, 100). La protoconcha (Figs. 101-103) del material de Mauritania tiene una vuelta de espira, el núcleo mide unos 220 μm, la primera media vuelta unos 390 μm y el diámetro total es de unas 540 μm; altura de unas 500 μm.

Distribución: Descrita del área de Dakar, Senegal, se ha encontrado ahora en Mauritania. Hay unas citas de DAUTZENBERG (1910) de *Donovania minima* Montagu, 1803 en Baie de Cansado y Pointe du Repos, que podrían referirse a esta especie.

Comentarios: Las conchas de Mauritania son muy semejantes a las de Senegal aunque en ellas se marca menos la diferencia de coloración entre los cordones espirales y sus interespacios (más claros y más semejantes en color que en las conchas de Senegal). Esta especie se puede confundir fácilmente con formas oscuras de *C. affinis*. Se distingue de ella principalmente por tener una última vuelta proporcionalmente más ancha, un canal sifonal algo más marcado y una sutura más profunda debido fundamentalmente al hundimiento la parte superior de la espira.

Chauvetia errata spec. nov. (Figs. 33-35, 104-108)

Donovania affinis en Dautzenberg, 1910, *Actes Soc. Linn. Bordeaux*: 66 (non *Donovania affinis* Monterosato, 1889)

Chauvetia affinis en Oliver y Rolán, 2008, *Iberus*, 26(2): 138, figs. 13, 14, 68, 93-98, 181, 189. (non *Donovania affinis* Monterosato, 1889).

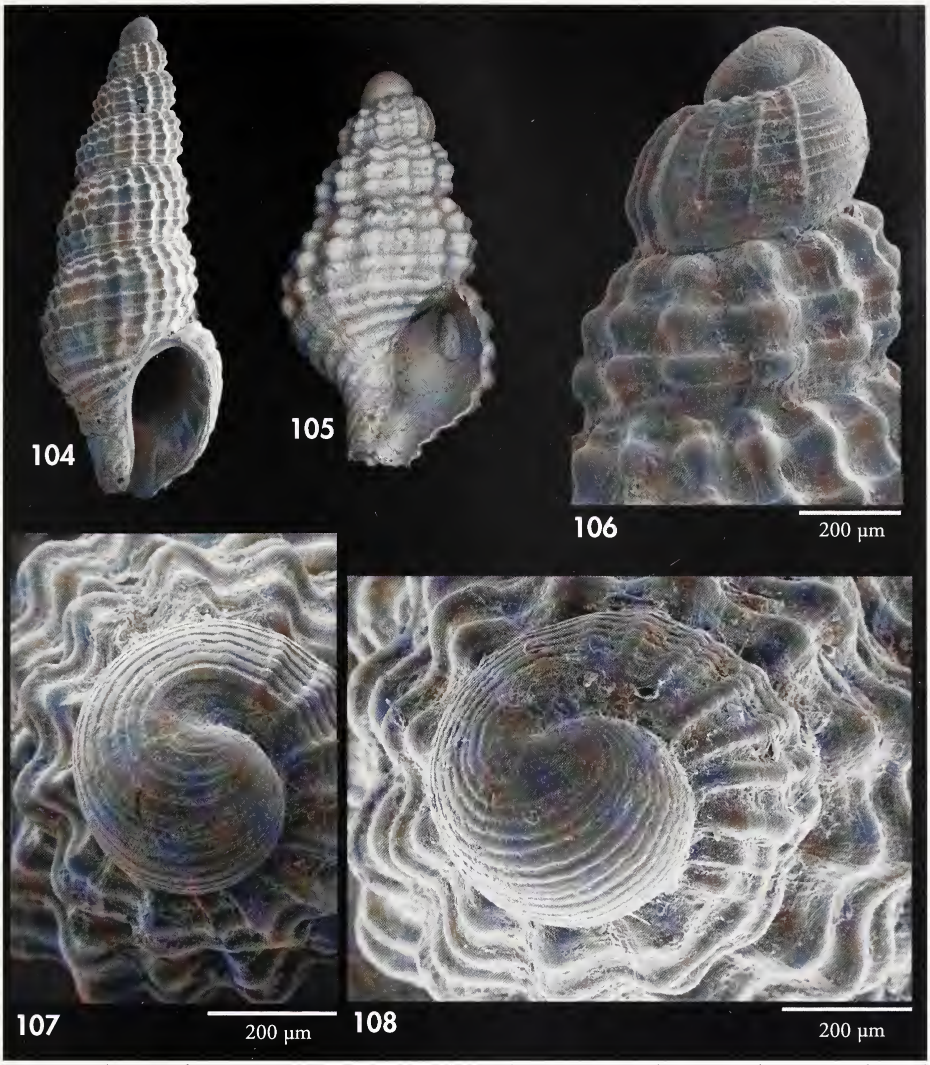
Material tipo: Holotipo (Figs. 33, 34) en MNHN. Ha sido representada en DAUTZENBERG (1910) como *C. affinis* en dragados frente Bel-Air y al oeste de Cap Rouge, Mission Gruvel. Paratipos: MNCN (1, 15.05/51080), MHNS (7) (Fig. 35), BMNH (1), CPR (1), CFS (1); todos conchas de Gorée, Dakar, Senegal.
Otro material examinado: MAURITANIA: 7 j, Baie de l' Étoile, Mauritania. Para otro material de SENEGAL: Ver OLIVER Y ROLÁN (2008).
Localidad tipo: Cap Rouge, Senegal.
Etimología: El nombre específico deriva de la palabra latina *erratus*, que significa equivocado, aludiendo al error en la determinación que se produjo en el anterior trabajo.

Descripción: Ver OLIVER Y ROLÁN (2008: 138, como *Chauvetia affinis*). Transcribimos aquí la descripción puesto que ahora se trata de una diferente consideración de la especie:

Concha (Figs. 33-35, 104, 105) fusiforme, aunque más cilíndrica que otras del género, sólida, con unas seis vueltas de espira.

Protoconcha (Figs. 106-108) paucispiral, con 0,8 vueltas, una anchura de 430 μm y una altura de 480 μm (núcleo: 270 μm y la primera media vuelta: 425 μm). Su escultura está formada, como en otras *Chauvetia*, por cordones espirales planos entre los que se aprecian surcos con incisiones axiales y que, al final, son unos 10 a 12 en número, algo variables, y más anchos que los interespacios. Al final de la protoconcha se aprecian unas cinco costillas axiales.

Teleoconcha con cuatro cordones espirales en la primera vuelta, el inferior más estrecho, y un quinto por arriba que está menos desarrollado y constituye un reborde inferior de la sutura. Un sexto cordón aparece en la penúltima vuelta a partir del cordón superior. La última vuelta representa el 55% de la altura total y, en ella, se aprecian seis cordones por encima de la inserción labial. De ellos los superiores están más juntos y son menos anchos que los restantes. Los interespacios son de una anchura similar a la de los cordones. En la base de la concha hay una decena de cordones que se van aproximando entre sí a medida que se acercan al final del canal sifonal. Las costillas axiales son casi ortoclinas y poco elevadas, y al cruzarse con los cordones espirales se forman tubérculos redondeados muy evidentes.



Figuras 104-108. *Chauvetia errata* spec. nov.; 104: concha, 5,7 mm, Dakar, Senegal; 105: concha, 2,4 mm, Baie de l'Étoile, Mauritania; 106, 107: protoconcha, Dakar; 108: protoconcha, Mauritania.
Figures 104-108. Chauvetia errata *spec. nov.; 104: shell, 5.7 mm, Dakar, Senegal; 105: shell, 2.4 mm, Baie de l'Étoile, Mauritania; 106, 107: protoconch, Dakar; 108: protoconch, Mauritania.*

En la última vuelta hay una veintena de costillas verticales, de anchura similar a los interespacios.

Abertura ovoide, representando el 37% de la altura total de la concha. El color de la misma es castaño, igual que la concha, y en ella se observan cinco dientes en el interior del labio externo. El inferior de ellos constituye el inicio del canal sifonal, que es corto y poco aparente.

Coloración de la concha castaño-rojiza. La base es algo más oscura y los tubérculos ligeramente más claros; la protoconcha puede tener un color más claro con una banda oscura en su centro.

Dimensiones: tiene una máxima dimensión de hasta 6 mm.

Animal blanco crema con aislados puntos blancos. Sifón más intenso de color. Opérculo (Oliver y Rolán, 2008: fig. 181) ovoide con el núcleo subterminal. Rádula (Oliver y Rolán, 2008: fig. 189) típica, con más de 150 filas de dientes, central rectangular, laterales con tres cúspides, la interna más pequeña.

Distribución: Conocida de Senegal, pero su área de distribución se extiende hasta Mauritania.

Comentarios: Aunque solo se ha encontrado en el actual área de estudio una escasa cantidad de material de esta especie, consideramos que es la misma especie que fue mencionada como *Chauvetia affinis* en un trabajo anterior (Oliver y Rolán, 2008). Después de su nuevo estudio, hemos comprobado que se trata de una especie válida diferente del taxon en la que se había situado incorrectamente en la publicación anterior, por lo cual le damos nombre en el presente trabajo.

La descripción original de Monterosato (1889) de *Chauvetia affinis* está basada en un único ejemplar recogido en Casablanca, al cual considera próximo a *Chauvetia minima*. En ese trabajo, Monterosato comenta que el motivo de considerarla una especie nueva es que había visto ejemplares mediterráneos de Taormina, Sicilia y de Pantellaria. En el MNHN se han encontrado conchas de la *Chauvetia* cf. *affinis* de localidad siciliana, enviadas por Monteroato a Locard y presumiblemente son las que han sido consideradas como *Chauvetia turritellata* por Micali (1999).

Varias son las especies con las que *C. errata* puede confundirse y con algunas de ellas comparte área de distribución. Así entre éstas tenemos a *C. lamyi*, *C. pardacuta*, *C. joani* y *C. tenebrosa*. Fuera del área de distribución se podría confundir con *C. affinis*, con *C. brunnea*, con *C. mamillata* o con conchas oscuras de *C. procerula*.

De *C. lamyi* se distingue por no tener tan evidente el canal sifonal. De *C. joani*, de *C. tenebrosa* y de *C. pardacuta* por ser menos fusiforme y por presentar un mayor número de costillas que al cruzarse con los cordones forman tubérculos redondeados. Además el canal sifonal no está tan inclinado como sucede en *C. joani*.

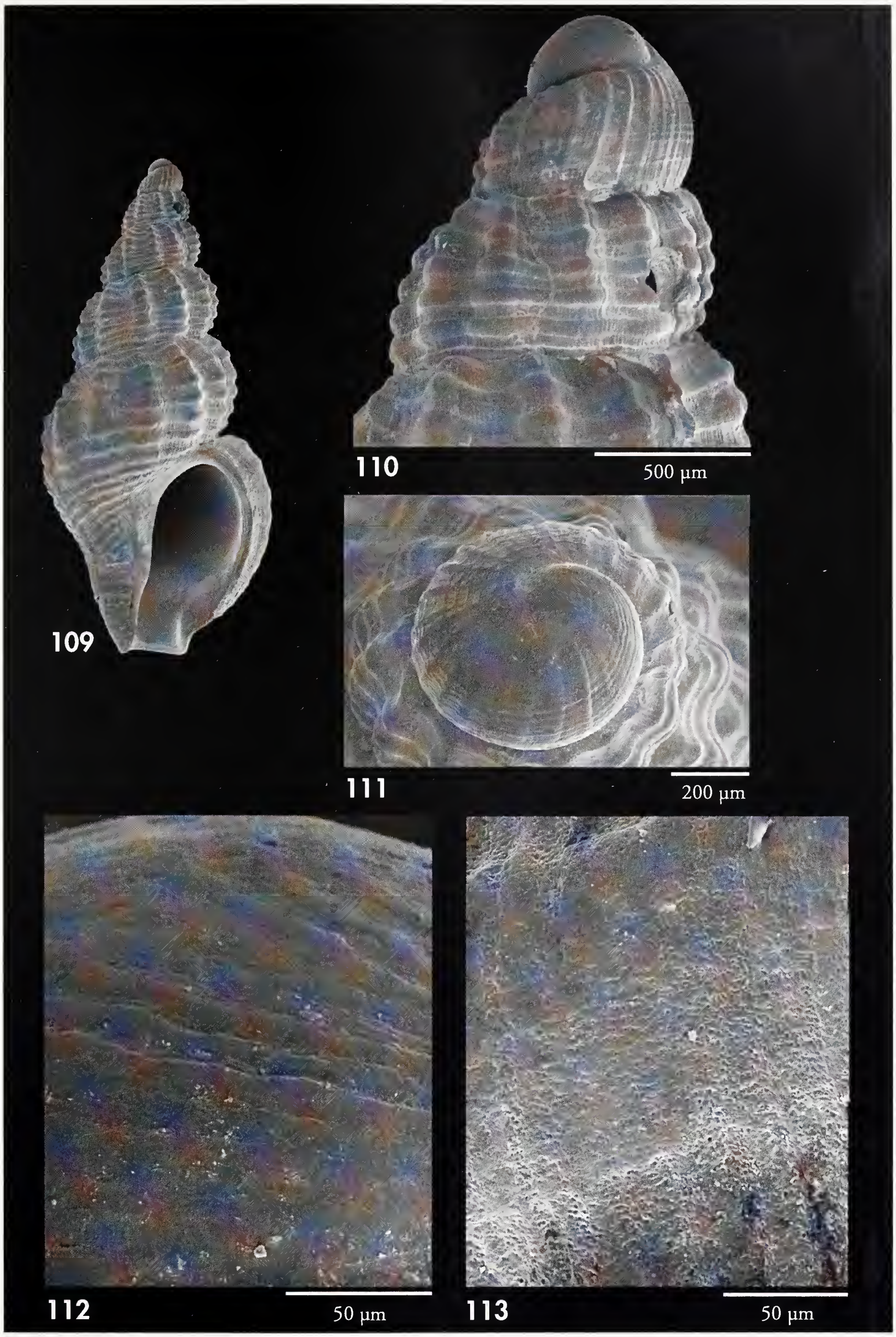
Fuera del área de distribución de la especie guarda semejanza con *C. affinis* con la que se ha confudido taxonomicamente, dado el parecido de su escultura. Se diferencia de ésta por tener más costillas que además son más estrechas y delicadas así como por la escultura de la protoconcha: *C. errata* tiene menos cordones y son claramente más anchos que sus interespacios lo que no sucede en las distintas variedades de *C. affinis*. Lo mismo se puede decir para distinguirla de *C. brunnea* y de *C. mamillata*. Por último la protoconcha de *C. procerula* es más parecida a la de *C. errata* pero la concha de *C. procerula* tiene un canal sifonal claro y unas costillas poco numerosas y evidentes.

Chauvetia megastoma spec. nov. (Figs. 36, 109-113)

Material tipo: Holotipo (Figs. 36, 109) en MNCN (15.05/51081) ex CHO.
Otro material estudiado: 1 j, de la localidad tipo, en MHNS.
Localidad tipo: Mauritania, 23° 15' N, 16° 06' W, a unos 200 m, en barcos de pesca.
Etimología: El nombre específico alude al tamaño de la abertura que es en proporción el más grande del género en relación a la altura de la concha.

Descripción: Concha (Fig. 36, 109) fusiforme, con cinco vueltas de espira.

Protoconcha (Figs. 110, 111) con una vuelta, y con una anchura de unos 670 μm (núcleo: 320 μm, primera media vuelta: 520 μm) y unas 630 μm de altura. Escultura basada cordoncillos espirales irregulares y poco definidos (Fig. 112) separados por interespacios más definidos, y en los que no se aprecian claramente las típicas incisiones de las *Chauvetia*. Con gran aumento (Fig. 113)



Figuras 109-113. *Chauvetia megastoma* spec. nov.; 109: holotipo, 7,2 mm (MNCN); 110, 111: protoconcha del holotipo; 112-113: microescultura de la protoconcha.

Figures 109-113. Chauvetia megastoma *spec. nov.; 109: holotype, 7.2 mm (MNCN); 110, 111: protoconch of the holotype; 112-113: microsculpture of the protoconch.*

pueden verse diminutas perforaciones. Tiene una treintena de costillas axiales algo sigmoideas y opistoclinas, poco relevantes. que se inician cerca del núcleo de la protoconcha, y son más estrechas que sus intervalos.

Teleoconcha con vueltas claramente convexas. Escultura de cordones espirales de anchura similar a sus interespacios al igual que sucede con las costillas. En el inicio de la teleoconcha aparecen cinco cordones espirales. En la última vuelta hay seis cordones por encima de la inserción labial y, hacia la base, aparecen de una docena de cordoncillos más. La escultura axial está formada por costillas convexas algo prosoclinas, una decena en la última vuelta. La última vuelta ocupa el 64 % de la altura total de la concha.

Abertura oval que alcanza el 43% de la altura de la concha. En el interior del labio externo de la concha estudiada no se han apreciado dientes salvo el pliegue que marca el inicio del borde externo del canal sifonal, que es corto pero claro y bastante abierto.

El color de la concha es blanco.

Dimensiones: Holotipo 7,2 x 3,0 mm.

Animal: Desconocido.

Distribución: La especie sólo ha sido recolectada en Mauritania.

Comentarios: Pese a la escasez de material, hemos decidido darle nombre porque tiene diferencias muy evidentes con las demás especies conocidas.

Se diferencia de *C. javieri* por tener las vueltas más convexas y la sutura más profunda, la última vuelta y la abertura proporcionalmente más altas y el canal sifonal más abierto en su parte superior. También hay diferencia en la escultura de la protoconcha, que en *Chauvetia javieri* tiene un mayor número de condoncillos axiales, que están más marcados.

De *Chauvetia hernandezi* spec. nov. se diferencia por el perfil más regular de sus vueltas, por la escultura de su protoconcha y por tener también proporcionalmente más alta tanto la última vuelta como su abertura.

De *Chauvetia edentula* spec. nov. (ver más abajo) se distingue claramente por su protoconcha y por la forma y el tamaño de su abertura bucal.

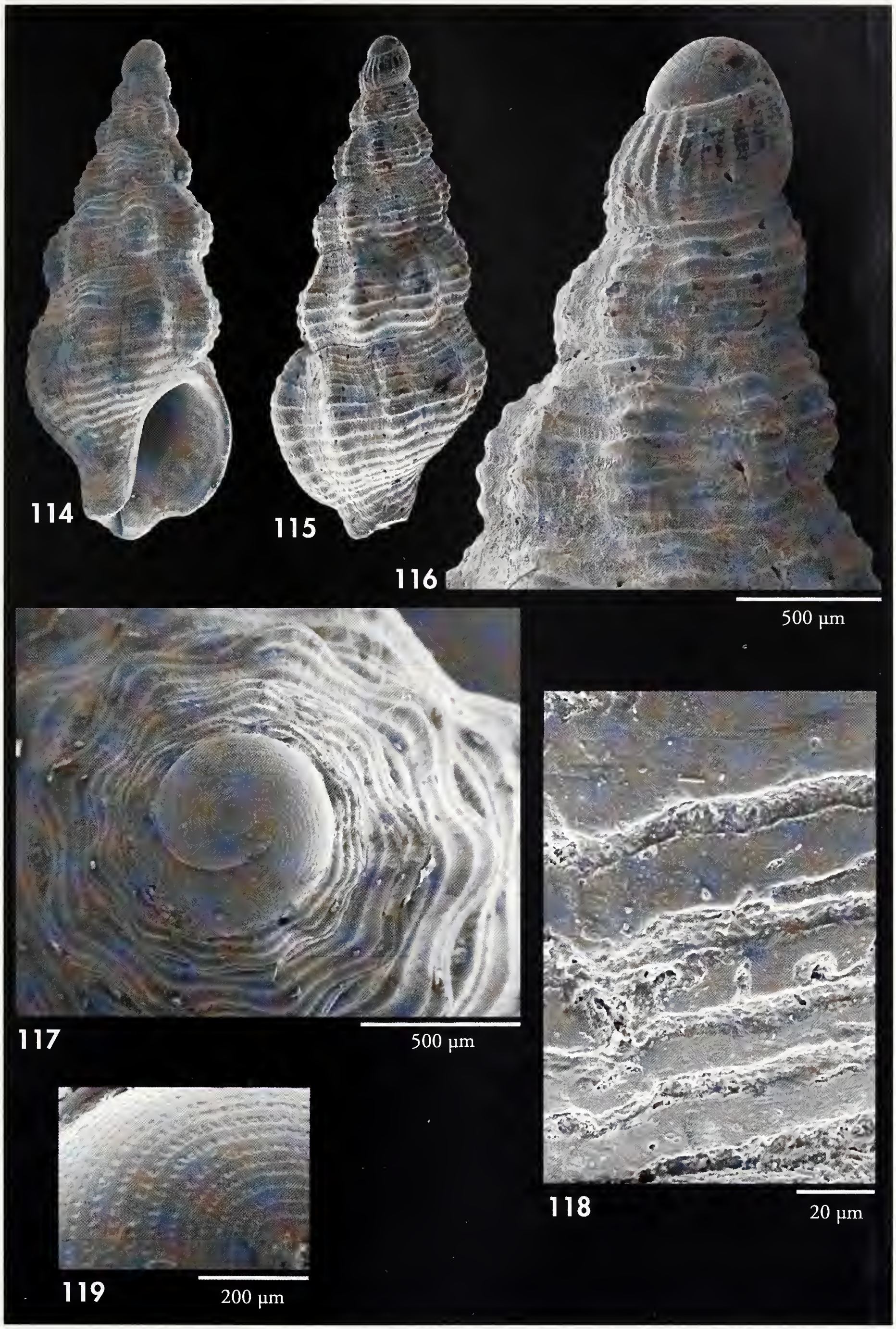
Chauvetia gigantissina sp. spec. nov. (Figs. 37-39)

Material tipo: Holotipo (Fig. 38) en MNCN (15.05/51082). Paratipos: 1 ej, Cabo Barbas, 22º 35' N, 16º 58' W, 32 m (MNHN); 1 c (Fig. 37), supuestamente, Sahara Occidental (CJH).
Localidad tipo: Sahara Occidental, 22º 05' N, 17º 11' W.
Etimología: El nombre específico hace alusión al gran tamaño de la especie, superior al de todas las conocidas en el género.

Descripción: Concha (Figs. 37, 38) fusiforme-alargada, sólida, con unas nueve vueltas de espira.

Protoconcha (Fig. 39) blanca, con 0,7 vueltas, y una anchura de unos 1000 μm (núcleo: 700 μm, primera media vuelta: 900 μm) y unas 1000 μm de altura; las protoconchas estudiadas estaban algo erosionadas y no se pudo apreciar bien su escultura espiral, aunque la axial estaba reducida a unas pocas costillas al final de la protoconcha.

Teleoconcha con una escultura de cordones espirales con anchura similar a sus interespacios al igual que sus costillas. En el inicio de la teleoconcha aparecen cuatro cordones espirales de los que el superior forma el reborde de la espira. No es hasta la sexta o séptima vuelta cuando aparece un quinto cordón a partir del cordón superior. Estos dos cordones son difícilmente distinguibles, tienen menor anchura, y se mantienen así hasta la última vuelta. En ésta, por encima de la inserción labial, están estos cinco cordones, y por debajo de ella hay una docena más que van disminuyendo en anchura y aproximándose entre ellos a medida que avanzan hacia el canal sifonal donde quedan muy juntos. La escultura axial es similar en grosor y



Figuras 114-119. *Chauvetia hernandezi* spec. nov.; 114, 115: 6,3 mm, 23º 05' N, 16º 28' W, Sahara; 116, 117: protoconchas; 118, 119: microescultura de la protoconcha.
Figures 114-119. Chauvetia hernandezi *spec. nov.; 114, 115: 6.3 mm, 23º 05' N, 16º 28' W, Sahara; 116, 117: protoconchs; 118, 119: microsculpture of the protoconch.*

está formada por costillas ortoclinas o muy poco prosoclinas, curvadas, que apenas se prolongan por debajo de la inserción labial acabando cerca del inicio del canal sifonal. Hay una veintena de costillas en la última vuelta. Al cruzarse cordones y costillas se forman nódulos ovoides. La ultima vuelta ocupa el 46 % de la altura total de la concha.

Abertura oval que alcanza el 32% de la altura de la concha. En el interior del labio externo se aprecian unos siete dientes de los que el inferior constituye el borde externo del canal sifonal. No se aprecia una escotadura clara en la base del labio externo por lo que el canal sifonal es corto y poco claro

Coloración de la concha castaño rojiza, con la protoconcha, el fondo de las primeras vueltas, y parte de la base y del canal sifonal muy claros, casi blancos.

Dimensiones: el holotipo mide 14,2 x 4,7 mm; el paratipo con la protoconcha rota (Fig. 37) mide 19,7 mm, y el otro paratipo con la protoconcha erosionada 19,9 mm.

Animal: Desconocido.

Distribución: Sólo conocida de Sahara. Una concha encontrada en Canarias, lo fue en un lugar de descarga de pescado, por lo que se puede suponer que tiene el mismo origen que el holotipo.

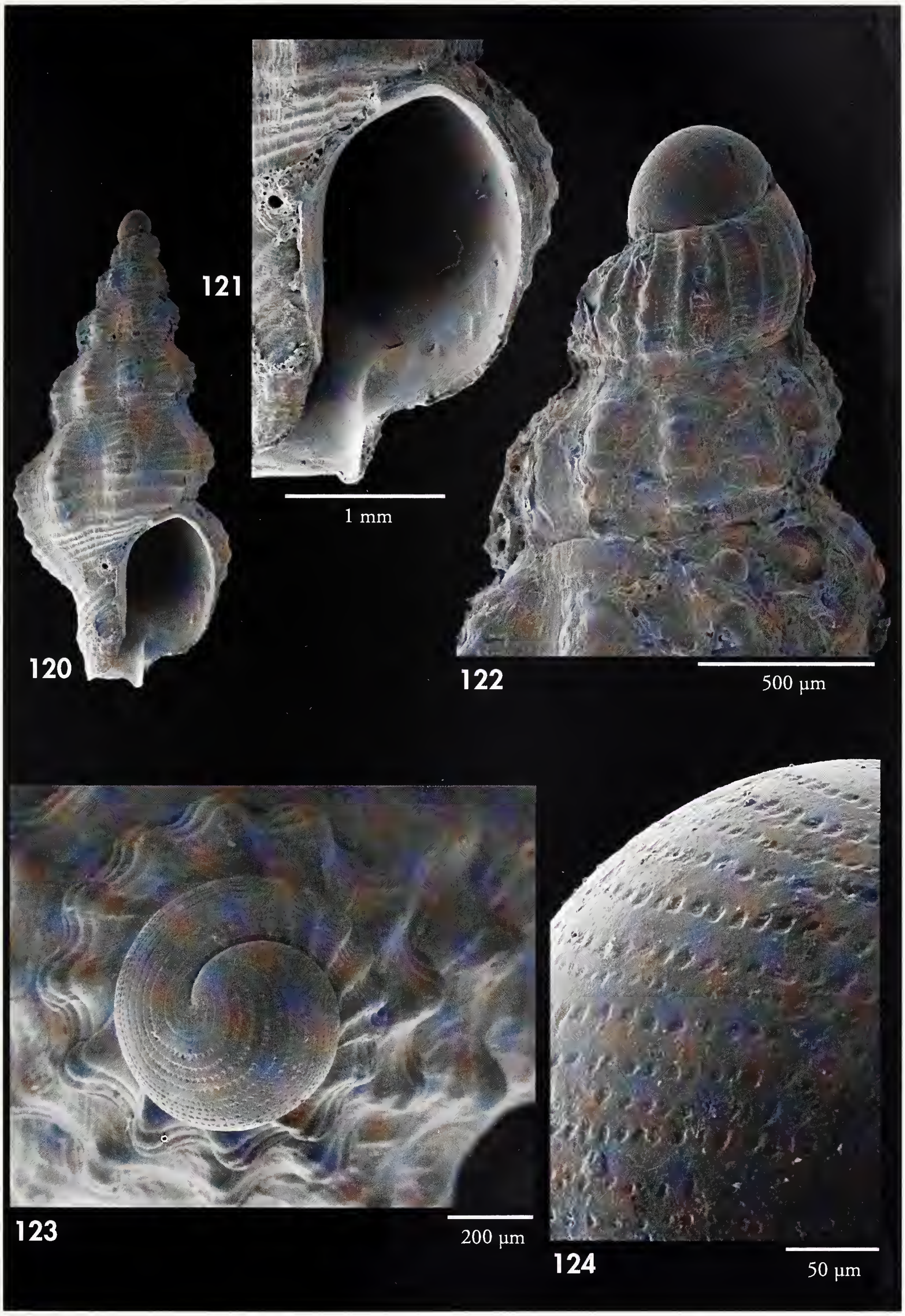
Comentarios: Se ha escogido como holotipo a la concha de menor tamaño por tener la protoconcha en mejor estado.

Esta especie por su tamaño (casi el doble de la mayoría de las especies del género) se diferencia de todas las conocidas tanto del Mediterráneo como de Senegal. Por otra parte, el patrón de color es totalmente diferente de todas ellas. La más próxima por color y tamaño sería *Chauvetia gigantea* Oliver y Rolán, 2008, de Senegal, pero se diferencia porque esta última tiene la protoconcha ligeramente más pequeña, la base y el ápice son menos blancos, las primeras vueltas de espira (hasta casi la penúltima) tienen solamente tres cordones espirales (contra 4-5 en la aquí descrita), los nódulos de entrecruzamiento de cordones y costillas son más claros y tanto costillas como cordones son menos prominentes.

Chauvetia hernandezi spec. nov. (Figs. 40-44, 114-119)

Material tipo: Holotipo (Figs. 40, 41) en el MNCN (15.05/51083). Paratipos en las siguientes colecciones: MNHN (1) (Fig. 42); MHNS (1) (Fig. 43, 44); BMNH (1), CPR (1), todos de la localidad tipo; CPB (1) (Fig. 114) de 23º 05′ N, 16º 28′ W, Sahara; CHO, de varias localidades del Sahara Occidental: (5 c) 23º 05′ N, 16º 28′ W; (4 c) 25º 45′ N, 15º 25′ W, Peña Grande, 36 m.

Otro material examinado: SAHARA: 1 j, 50-60 m (CFS); 2 c, 1 j, lote 281, 23º 05′ N, 16º 28′ W (CHO); 7 c, lote 294, 23º 05′ N, 17º 00′ W, 34 m (CHO); 4 c, 22º 00′ N, 17º 22′ W, 84 m (CHO); 1 c, lote 283, 24º 81′ N, 15º 51′ W (CHO); 6 c, 23º 65′ N, 15º 51′ W (CHO); 1 c, lote276, 22º 55′ N, 16º 36′ W (CHO); 1 c, lote 202, 22º 35′ N, 16º 58′ W (CHO); 1 c, lote 268, 24º 28′ N, 15º 51′ W (CHO); 19 c, lote 293, 22º 35′ N, 16º 58′ W, 58 m (CHO); 1 c, lote 249, 22º 00′ N, 17º 22′ W, 84 m (CHO); 7 c, lote 270, 23º 05′ N, 16º 28′ W (CHO); 2 c, lote 217, 22º 05′ N, 17º 11′ W (CHO); 1 c, lote 237, 24º 05′ N, 15º 25′ W (CHO); 1 c, lote 206, 23º 08′ N, 16º 25′ W (CHO); 1 c, 1 j, lote 267, 24º 28′ N, 15º 51′ W (CHO); 1 c, lote 238, 24º 05′ N, 15º 25′ W (CHO); 1 c, lote 292, 22º 35′ N, 16º 58′ W, 58 m (CHO); 1 c, lote 300, 22º 17′ N, 17º 22′ W, 84 m (CHO); 2 c, lote 291, M/8-9, 23º 05′ N, 16º 28′ W, 2 m (CHO); 1 c, lote 289, 24º 51′ N, 15º 25′ W (CHO); 1 c, lote 216, 22º 05′ N, 17º 11′ W (CHO); 3 c, lote 253, Sur Peña Grande 24º 45′ N, 15º 25′ W, 32 m (CHO); 1 c, lote 255, 23º 08′ N, 16º 00′ W (CHO); 1 c, lote 233, 23º 08′ N, 16º 20′ W (CHO); 3 c, M-13, 23º 05′ N, 17º 00′ W, 36 m (CHO); 2 c, lote 284, 24º 28′ N, 15º 51′ W (CHO); 3 c, lote 209, 23º 08′ N, 16º 25′ W (CHO); 1 j, lote 263, 25º 17′ N, 15º 22′ W (CHO); 3 c, lote 266, 22º 05′ N, 17º 11′ W (CHO); 1 c, 23º 10′ N, 16º 28′ W, 64 m, arrastre (CHO); 1 c, 22º 35′ N, 16º 58′ W, 90 m, arrastre en arena (CHO); 2 c, lote 242, 23º 05′ N, 17º 00′ W (CHO); 1 c, M/8-9, 23º 05′ N, 16º 28′ W, 30 m (CHO); 1 c, lote 236, 23º 08′ N, 16º 26′ W (CHO); 1 ej, 2345, 24º 00′ N, 16º 00′ W 30-35 m (CHO); 5 ej, lote 258, 23º 08′ N, 16º 25′ W, 30 m (CHO); 3 ej, lote 257, 25º 45′ N,



Figuras 120-124. *Chauvetia distans* spec. nov.; 120: holotipo, 6,8 mm, 23º 05' N, 16º 35' W, 37 m (MNCN); 121: detalle de la abertura; 122, 123: protoconcha; 124: microescultura de la protoconcha.

Figures 120-124. Chauvetia distans *spec. nov.; 120: holotype, 6.8 mm, 23º 05' N, 16º 35' W, 37 m (MNCN); 121: detail of the aperture; 122, 123: protoconch; 124: microsculpture of the protoconch.*

15° 25′ W, Peña Grande, 36 m (CHO); 48 ej, varias etiquetas de localización 10-20 m (CHO); 2 ej, 25° 45′ N, 15° 25′ W, 35 m, Peña Grande (CHO); 3 c, lote 249 (MHNS). MAURITANIA: 1 c, lote 223, MM0004 (CHO).

Localidad tipo: Sahara Occidental, 22° 35′ N, 16° 58′ W, Cabo Barba, 58 m.

Etimología: La especie se dedica a la memoria de José María Hernández, malacólogo de Gáldar, Gran Canaria, que contribuyó a este trabajo con una gran cantidad de material de su colección.

Descripción: Concha (Figs. 40-44, 114, 115) fusiforme-alargada, sólida, con unas siete vueltas de espira.

Protoconcha (Figs. 116, 117) con una vuelta y con una anchura de unos 700 μm (núcleo: 410 μm, primera media vuelta: 600 μm) y unas 380 μm de altura. Escultura formada por una veintena de cordoncillos espirales planos, de anchura variable separados por interespacios que presentan las típicas incisiones del género (Fig. 119) y cuya anchura es por lo general menor o igual que la de los cordones. Al final de la protoconcha aparecen unas ocho costillitas muy juntas y la escultura de los interespecios de los cordones desaparece (Fig. 118).

Teleoconcha: El perfil de las vueltas es convexo con la sutura profunda, aunque la mitad superior de la espira es ligeramente cóncava. Escultura de cordones espirales de anchura desigual (los superiores son más estrechos) aunque similares o algo más estrecho que sus respectivos interespacios. Costillas menos anchas que sus interespacios y que suelen ser más relevantes hacia el final de la concha. En el inicio de la teleoconcha aparecen seis cordones espirales siendo el superior el reborde de la espira. En la última vuelta hay ocho cordones por encima de la inserción labial de los que los tres (o cuatro) superiores son claramente de menor anchura y, hacia la base, aparece una quincena de cordoncillos más. Los superiores están claramente separados por interespacios claros y a medida que se acercan al canal sifonal se van aproximando entre ellos, quedando los más inferiores muy juntos. La escultura axial está formada por costillas convexas ortoclinas o muy poco prosoclinas, una decena en la última vuelta que apenas se prolongan por debajo de la inserción labial. La ultima vuelta ocupa el 58 % de la altura total de la concha. Con grandes aumentos es posible observar escultura axial muy fina entre los cordones, como líneas de crecimiento muy marcadas.

Abertura oval que alcanza el 40% de la altura de la concha. En el interior del labio externo se aprecian de siete a diez dientes siendo el inferior el borde externo del canal sifonal, que es corto y bastante abierto.

Coloración de la concha marrón amarillento o rojizo, aunque hay conchas totalmente blancas.

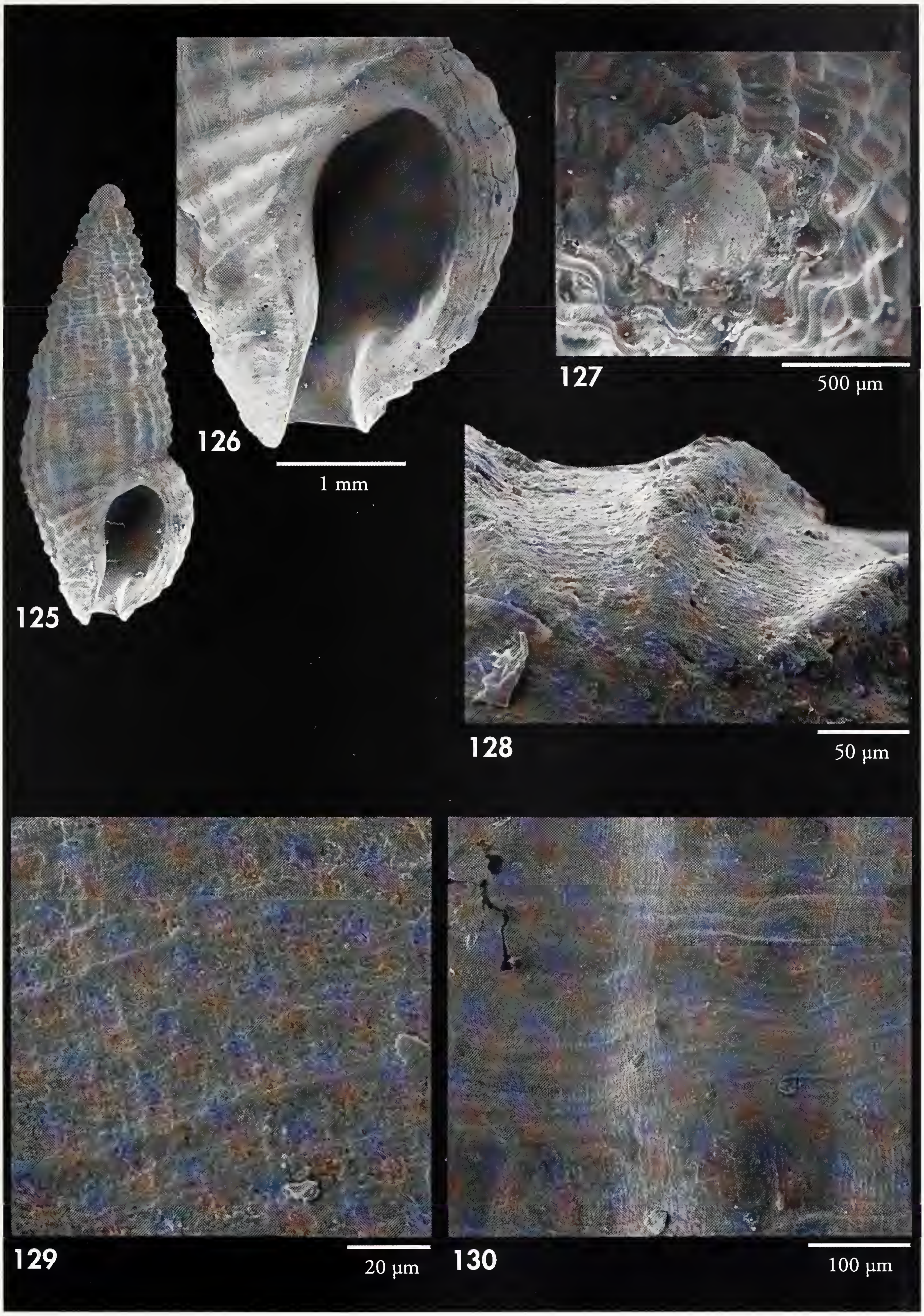
Dimensiones: Holotipo 8,6 x 3,6 mm; paratipos de unas dimensiones similares, alguno llega a 11 mm.

Animal: El animal es blanco grisáceo con puntos blanco amarillentos.

Distribución: La especie estaría presente en gran abundancia en Sahara. No obstante, en el material estudiado, hay una concha recolectada en Mauritania.

Comentarios: La especie mediterránea más parecida es *Chauvetia procerula*, de la que se distinguiría por tener un canal sifonal menos definido y por presentar más cordones espirales (ocho en la última espira frente a los cinco de *C. procerula*).

De las especies africanas la más parecida es *Chauvetia distans* spec. nov. (ver comentarios en esta última). También se podría confundir con *Chauvetia joani*, con *C. javieri* o con *Chauvetia megastoma*. De *C. joani* se distinguiría por el mayor número de cordones espirales en su última vuelta y porque el canal sifonal no presenta la tendencia tan acusada de inclinarse hacia la derecha. De *C. javieri* se distingue fundamentalmente por su protoconcha ya que sólo presenta claramente unas pocas costillas localizadas al final de la protoconcha. Respecto a *C. megastoma* ver comentarios en esta especie.



Figuras 125-130. *Chauvetia austera* spec. nov.; 125: paratipo, 7,8 mm, 23° 05' N, 17° 00' W, Sahara (MNHN). 126: detalle de la abertura; 127: protoconcha; 128, 129: microescultura de la protoconcha; 130: microescultura de la teleoconcha.

Figures 125-130. Chauvetia austera *spec. nov.; 125: paratype, 7.8 mm, 23° 05' N, 17° 00' W, Sahara (MNHN). 126: detail of the aperture; 127: protoconch; 128, 129: microsculpture of the protoconch; 130: microsculpture of the teleoconch.*

Chauvetia distans spec. nov. (Figs. 45-48, 120-124)

Material tipo: Holotipo (Figs. 45, 46, 120) en el MNCN (15.05/51084). Paratipos del Sahara Occidental: MNHN (1) (Fig. 47) 23° 05′ N, 16° 00′ W; BMNH (1) 23° 05′ N, 17° 05′ W (Fig. 48); CPR (1) 23° 05′ N, 17° 05′ W; CHO (4 c en varios lotes): (2 c) 23° 05′ N, 17° 00′ W; (1 c) 22° 05′ N, 17° 11′ W ; (1 c) 23° 05′ N, 17° 05′ W; MHNS (1 c) lote 225, 23° 15' N, 16° 40' W, Mauritania.
Localidad tipo: Sahara Occidental, 23° 05′ N, 16° 35′ W, 37 m.
Etimología: El nombre específico alude a la separación existente entre las costillas axiales.

Descripción: Concha (Figs. 45-48, 120) fusiforme, sólida, con unas seis vueltas de espira convexas.

Protoconcha (Figs. 122, 123) con una vuelta, y con una anchura de unos 610 µm (núcleo: 310 µm, primera media vuelta: 500 µm) y unas 650 µm de altura; escultura basada en los típicos cordones espirales separados por interespacios con incisiones típicas de las *Chauvetia* (Fig. 124). Hay una quincena de cordones espirales planos, de anchura parecida y claramente más anchos que los interespacios. En el último cuarto de la protoconcha aparecen unas ocho costillitas que van ensanchándose a medida que nos acercamos al final de la protoconcha.

Teleoconcha con perfil de las vueltas convexo y la sutura profunda aunque la mitad superior de la espira es ligeramente cóncava. Los cordones espirales son de anchura desigual similar a sus interespacios. Costillas convexas menos anchas que sus interespacios. En el inicio de la teleoconcha aparecen unos cinco o seis cordones espirales de los que el superior constituye el reborde de La espira. En la última vuelta hay ocho cordones por encima de la inserción labial siendo los cuatro superiores claramente más estrechos que los inferiores. Hacia la base, aparece una quincena de cordoncillos más. La escultura axial está formada por costillas ortoclinas, una decena en la última vuelta que se prolongan algo por debajo de la inserción labial, acabando cerca del inicio del canal sifonal. El contorno de las vueltas es algo dentado debido a la prominencia de los cordones espirales. En la mitad inferior de la última vuelta los cordones espirales son más finos y están más juntos. Esta última vuelta ocupa el 60 % de la altura total de la concha.

Abertura (Figs. 121) redondeada que alcanza el 39% de la altura de la concha. En el interior del labio externo se aprecian unos siete dientes de los que el inferior constituye el borde externo del canal sifonal. El canal sifonal es, aunque corto, claro debido tanto al ligero estrechamiento de la parte inferior del borde externo del canal sifonal como a la presencia de una clara escotadura en la base del labio externo.

Color de la concha crema con la base blanca, aunque hay conchas totalmente blancas.

Dimensiones: Holotipo 6,8 mm; paratipos con unas dimensiones similares, alguno algo mayor.

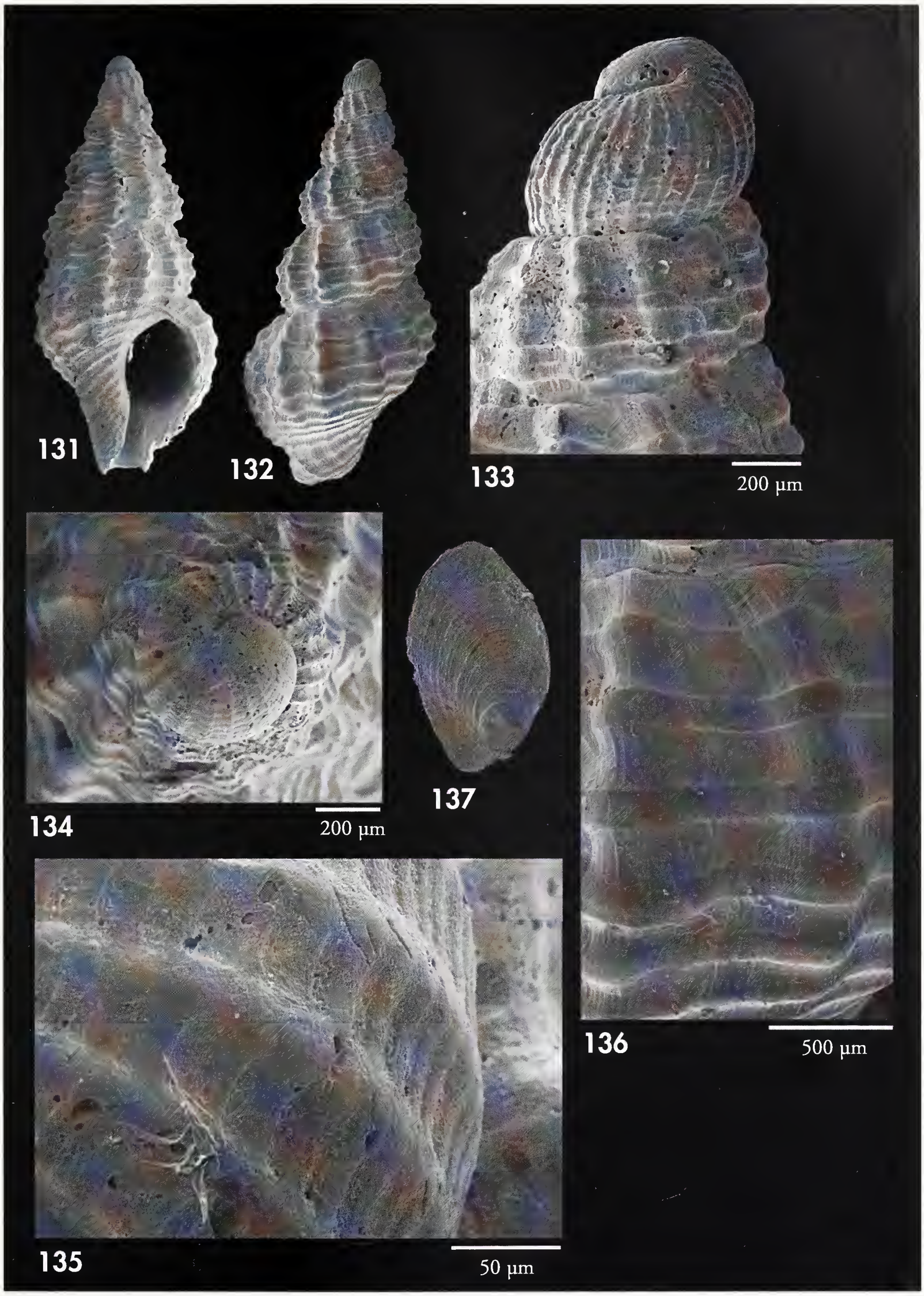
Animal: Desconocido.

Distribución: Mauritania y Sahara.

Comentarios: Se podría confundir con ejemplares de *Chauvetia hernandezi* spec. nov. ya que ambas tienen un similar perfil de espira pero su escultura más pronunciada y su evidente canal sifonal las diferencian. También la protoconcha de *C. distans* spec. nov. presenta menos cordones, que son más anchos y sus costillas parecen ser más pronunciadas que las de *C. hernadezi*.

Chauvetia austera spec. nov. (Figs. 49-52, 125-130)

Material tipo: Holotipo (Figs. 49, 50) en MNCN (15.05/51085). Paratipo (Fig. 51) en MNHN.
Localidad tipo: Sahara Occidental, 23° 05′ N, 17° 00′ W (exCHO)
Etimología: El nombre específico hace alusión a que la especie no tiene muchas diferencias en sus caracteres morfológicos generales sobre otras del grupo.



Figuras 131-137. *Chauvetia peculiaris* spec. nov.; 131: paratipo, 5,8 mm, 22º 00' N, 17º 22' W, 46 m; 132: holotipo, 7,7 mm, 22º 00' N, 17º 22' W, 46 m (MNCN). 133, 134: protoconcha; 135: detalle de la microescultura de la protoconcha; 136; detalle de la escultura de la teleoconcha; 137: opérculo, 1,3 mm.

Figures 131-137. Chauvetia peculiaris *spec. nov.; 131: paratype, 5.8 mm, 22º 00' N, 17º 22' W, 46 m; 132: holotype, 7.7 mm, 22º 00' N, 17º 22' W, 46 m (MNCN). 133, 134: protoconch; 135: detail of the microsculpture of the protoconch; 136; detail of the sculpture of the teleoconch; 137: operculum, 1.3 mm.*

Descripción: Concha (Figs. 49-51, 125) fusiforme-alargada, sólida, con unas seis vueltas de espira.

Protoconcha (Fig. 52, 127) con 0,8 vueltas, y con una anchura de unos 720 μm (núcleo: 600 μm, primera media vuelta: 670 μm) y unas 600 μm de altura. Escultura espiral obsoleta (Figs. 128, 129) y costillas fuertes iniciándose prácticamente al finalizar el núcleo. La transición con la teleoconcha, si nos fijamos en su escultura, no resulta tan clara como en otras *Chauvetia* pero el cambio de color, dado que su protoconcha es blanca, nos ayuda a apreciarla.

Teleoconcha con vueltas de perfil planoconvexo con la sutura poco profunda. Escultura basada en cordones espirales con anchura similar a sus interespacios al igual que sus costillas que son poco pronunciadas. En el inicio de la teleoconcha aparecen cuatro cordones espirales, formando el superior el reborde de la espira. En la cuarta vuelta aparece por encima de éste un quinto cordón. En la última vuelta hay cinco cordones por encima de la inserción labial prácticamente de la misma anchura y, hacia la base, aparecen seis o siete cordoncillos más. La escultura axial, poco pronunciada, es similar en grosor y está formada por costillas ortoclinas o muy poco prosoclinas, que son unas dieciocho en la última vuelta. Se prolongan por debajo de la inserción labial acabando cerca del inicio del canal sifonal. Al cruzarse cordones y costillas se forman nódulos redondeados. Con grandes aumentos (Fig. 130) puede apreciarse una microescultura muy fina de líneas axiales y algunos filetes espirales irregulares. La última vuelta ocupa el 55 % de la altura total de la concha.

Abertura oval que alcanza el 38 % de la altura de la concha. En el interior del labio externo se aprecian cuatro dientes de los que el superior es más pronunciado y el inferior constituye el borde externo del canal sifonal, que es corto y abierto.

Coloración de la concha blanco amarillenta con líneas espirales rojizas. En algunas conchas estas líneas coinciden con los cordones espirales mientras que en otras coinciden con los interespacios. Las suturas, la base de la concha y el canal sifonal suelen ser también rojizos. La protoconcha es de color blanco.

Dimensiones: Holotipo 8,4 mm; paratipo con una altura de 7,8 mm.

Animal: Desconocido.

Distribución: Sólo conocida por ejemplares procedentes del Sahara.

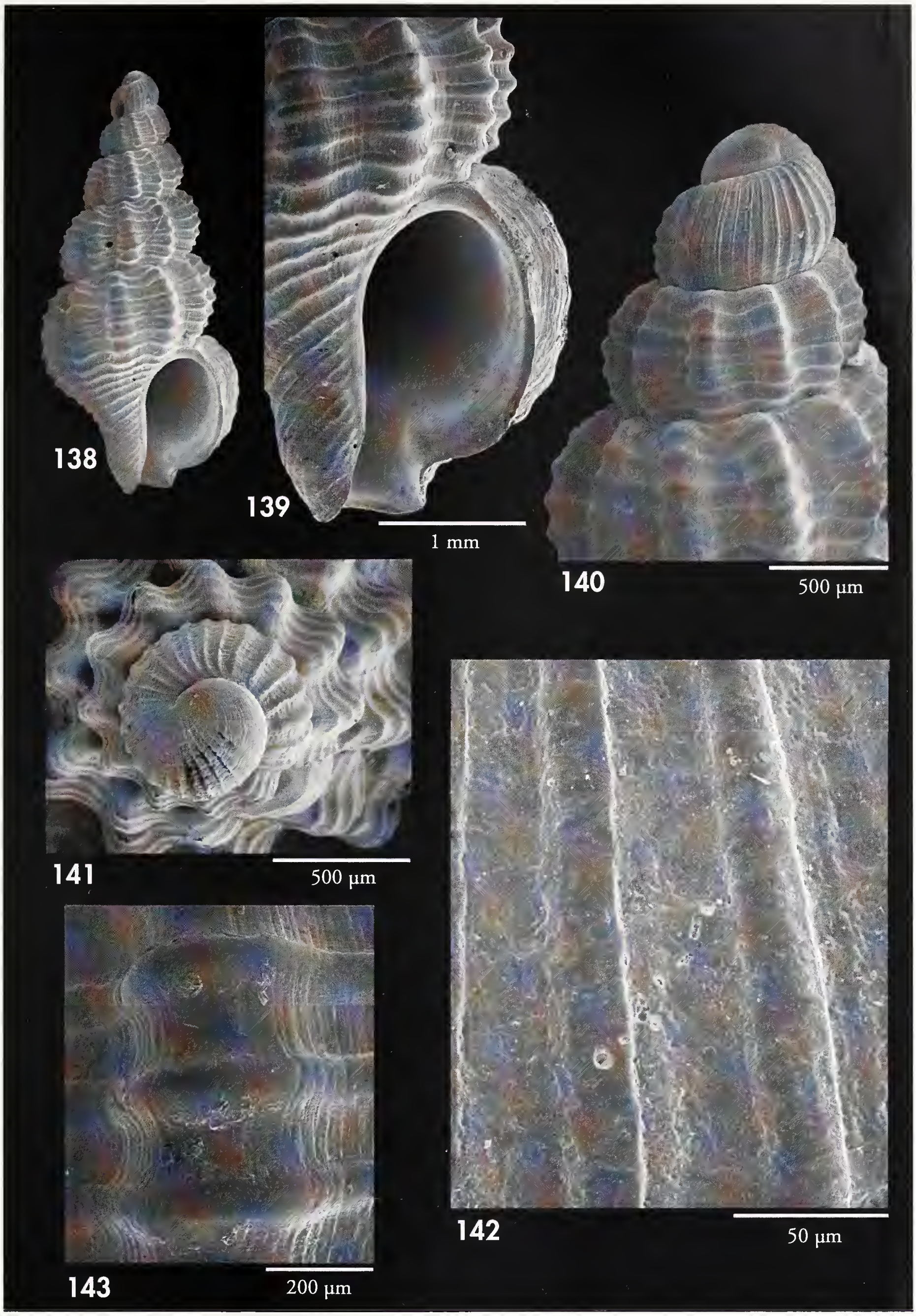
Comentarios: Por la escultura de su protoconcha se aproximaría a *Chauvetia retifera* (Brugnone, 1880), *C. tenuisculpta* Dautzenberg, 1912 o *C. multilirata* Oliver y Rolán, 2008, pero las dos primeras son de mayor tamaño, presentan tres cordones espirales en la primera vuelta y la anchura de sus cordones es claramente más ancha que sus interespacios. Además *C. retifera* tiene color marrón rojizo y *C. tenuisculpta* es blanca. En cuanto a la protoconcha en *C. tenuisculpta* sus costillas se inician ya en el núcleo.

El único ejemplar de *C. multilirata* estudiado era de color blanco sucio, presentaba también los cordones espirales más anchos que sus interespacios, así como sus costillas y su protoconcha tenía las costillas menos pronunciadas.

Otra especie presente en Senegal, *C. luciacuestae* Oliver y Rolán, 2008, también guarda cierto parecido si bien la coloración rojiza de esta última afecta únicamente a los nódulos. La protoconcha las diferencia claramente ya que *C. luciacuestae* carece de costillas axiales en casi su mayor parte.

Chauvetia peculiaris spec. nov. (Figs. 53, 54, 131-137)

Material tipo: Holotipo (Fig. 53-54, 132) en MNCN (15.05/51086). Paratipos, todos de Sahara Occidental: MNHN (1 c) 23° 65′ N, 15° 25′ W; MHNS (1 c) (Fig 131) 23° 09′ N, 16° 25′ W; CHO (1 c) 23° 09′ N, 16° 25′ W¸ (1 c) 22° 00′ N, 17° 22′ W; CPR (1 ej) recolectada por pescadores.
Localidad tipo: Sahara, 22° 00′ N, 17° 22′ W, 46 m.
Etimología: El nombre específico hace alusión al carácter poco común de los cordones espirales más anchos de la protoconcha.



Figuras 138-143. *Chauvetia edentula* spec. nov. 138: holotipo, 6,3 mm, 22º 05' N, 17º 11' W, 77 m, Sahara (MNCN); 139: detalle de la abertura; 140, 141: protoconcha, Arguineguín, Gran Canaria, 377 m; 142: detalle de la protoconcha; 143: detalle de la escultura.

Figures 138-143. Chauvetia edentula *spec. nov. 138: holotype, 6.3 mm, 22º 05' N, 17º 11' W, 77 m, Sahara (MNCN); 139: detail of the aperture; 140, 141: protoconch, Arguineguín, Gran Canaria, 377 m; 142: detail of the protoconch; 143: detail of the sculpture.*

Descripción: Concha (Figs. 53, 54, 131, 132) fusiforme-alargada, sólida, con unas seis vueltas de espira.

Protoconcha (Figs. 133, 134) con una vuelta, y con una anchura de unas 570 µm (núcleo: 330 µm, primera media vuelta: 530 µm) y unas 630 µm de altura. Escultura basada en unos 16-18 cordoncillos espirales, de anchura similar a los interespacios (Fig. 135). Las costillas de la protoconcha se inician a partir del núcleo y en un número entre 20 y 25 cruzan los cordones dándole un aspecto reticulado.

Teleoconcha con una escultura de cordones espirales de anchura similar o algo menor que sus interespacios (Fig. 136). Costillas algo más estrechas que sus interespacios. En el inicio de la teleoconcha aparecen cinco cordones espirales siendo el superior el reborde de la espira. En la última vuelta se mantienen estos cinco cordones por encima de la inserción labial. En la base hay una decena de cordoncillos más estrechos. La escultura axial está formada por costillas convexas algo prosoclinas, una docena en la última vuelta que se prolongan por debajo de la inserción labial. La ultima vuelta ocupa el 60 % de la altura total de la concha.

Abertura oval que alcanza el 40% de la altura de la concha. En el interior del labio externo se aprecian unos dientes constituyendo el inferior el borde externo del canal sifonal que, aunque es muy corto es claro, debido al estrechamiento de la parte inferior del margen externo del canal sifonal y a la presencia de una escotadura en la base del labio externo.

El color de las escasas conchas estudiadas era crema con una banda algo más oscura a la altura de la inserción labial y una base con el canal sifonal blanco.

Dimensiones: Holotipo 7,7 x 3,4 mm; paratipos de unas dimensiones similares.

Animal: Desconocido. Opérculo (Fig. 137) ovoide con el núcleo subterminal.

Distribución: La especie solo se ha localizado en las costas del Sahara.

Comentarios: El tipo de protoconcha con costillas axiales en toda su extensión la relaciona con el grupo de *C. javieri*.

Se diferencia de esta especie por tener en la teleoconcha unas costillas más pronunciadas, un canal sifonal más claro y menos cordones espirales (en la última vuelta hay cinco cordones de anchura similar a los interespacios por encima de la inserción labial mientras que en *C. javieri* suele haber seis o siete, que además tienen una anchura claramente superior a sus interespacios). En cuanto a la protoconcha, la de *C. javieri* es más alta y presenta más costillitas axiales (más de 30 vs. unas 24), teniendo además más cordoncillos espirales.

De *Chauvetia distans* spec. nov. y de *C. hernandezi* spec. nov. se distingue por el tipo de protoconcha ya que en ellas no hay escultura axial en toda su extensión.

De *Chauvetia megastoma* spec. nov. se distingue por tener menos cordones espirales, un canal sifonal más marcado y por la diferente escultura de su protoconcha.

Chauvetia edentula spec. nov. (Figs. 55-59, 138-143)

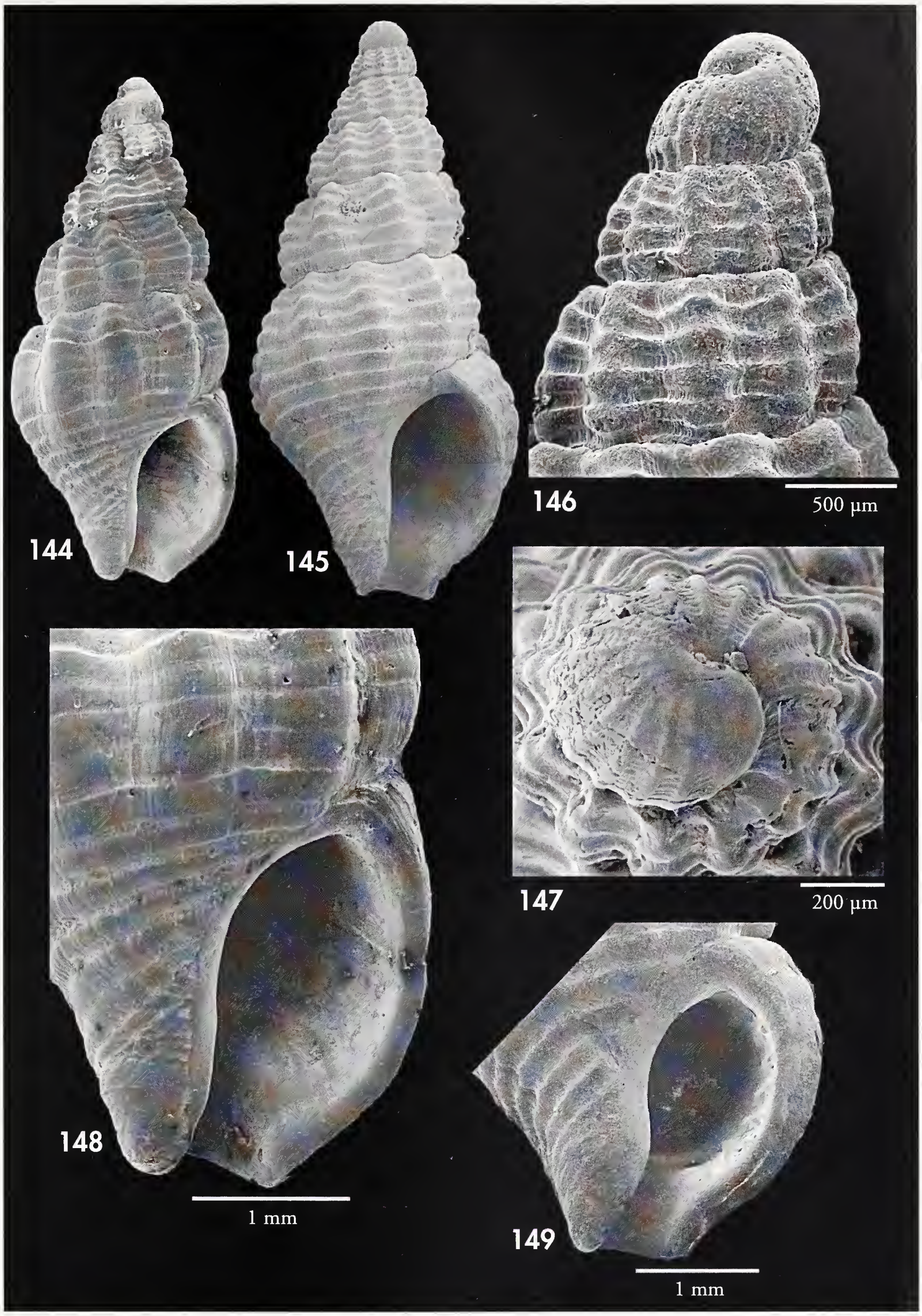
Material tipo: Holotipo (Figs. 55-57, 138, 139) en MNCN (15.05/51087) (Figs. 138-140). Paratipos: MNHN (1), MHNS (1), BMNH (1), CPR (1), CHO (6 c, 4 j, Figs. 58, 59). Todos de Arguineguín, N de Gran Canaria, 377 m.

Localidad tipo: Sahara Occidental, 22° 05′ N, 17° 11′ W, 77 m.

Etimología: El nombre específico alude a la ausencia de dientes en la abertura, pese a que el labio se encuentra bien desarrollado.

Descripción: Concha (Figs. 55-59, 138) fusiforme-alargada sólida, con unas seis vueltas de espira.

Protoconcha (Figs. 140, 141) con una vuelta, y con una anchura de unos 720 µm (núcleo: 350 µm, primera media vuelta: 550 µm) y unas 750 µm de altura. Escultura (Fig. 142) formada por unas 26 costillas axiales que comienzan a partir del núcleo y son cruzadas por muchos



Figuras 144-149. *Chauvetia borgesi* spec. nov.; material de Canarias: 144, 145: paratipos, 6,3 mm, Sardina, Gran Canaria (MHNS); 7,1 mm, Gando, Gran Canaria (MHNS); 146, 147: protoconcha; 148, 149: detalle de la abertura.

Figures 144-149. Chauvetia borgesi *spec. nov.; material from Canaries: 144, 145: paratypes, 6.3 mm, Sardina, Gran Canaria (MHNS); 7.1 mm, Gando, Gran Canaria (MHNS); 146, 147: protoconch; 148, 149: detail of the aperture.*

cordoncillos espirales de anchura desigual, al igual que sus interespacios, menos definidas que en otras especies, pero muy numerosos, pudiendo llegar a ser 40 o más. Entre las costillas es donde se aprecia mejor la escultura espiral.

Teleoconcha con vueltas convexas y sutura profunda. Escultura (Fig. 143) de cordones espirales de anchura similar o algo menor que sus interespacios al igual que las costillas. En el inicio de la teleoconcha aparecen seis cordones espirales siendo el superior sólo el reborde superior de la espira y no se separa hasta la tercera vuelta. En la última vuelta hay seis cordones por encima de la inserción labial y, hacia la base, aparece una quincena de cordoncillos más, separados por interespacios claros. La escultura axial está formada por costillas convexas ortoclinas o muy poco prosoclinas, una decena en la última vuelta que apenas se prolongan por debajo de la inserción labial. La ultima vuelta ocupa el 57% de la altura total de la concha. Abertura oval-redondeada que alcanza el 37% de la altura de la concha. En el interior del labio externo no se aprecia en las conchas estudiadas dientes (Fig. 139) salvo en la parte inferior, en lo que podríamos considerar como el borde externo del canal sifonal, que aunque corto es claro.

Coloración de la concha suele ser amarillenta con la base algo mas oscura.

Dimensiones: Holotipo 6,3 x 3,1 mm; paratipos algo más pequeños.

Animal: Desconocido.

Distribución: La especie estaría presente en el Sahara y en Canarias, siendo una especie de más profundidad que la mayoría de las especies de *Chauvetia*.

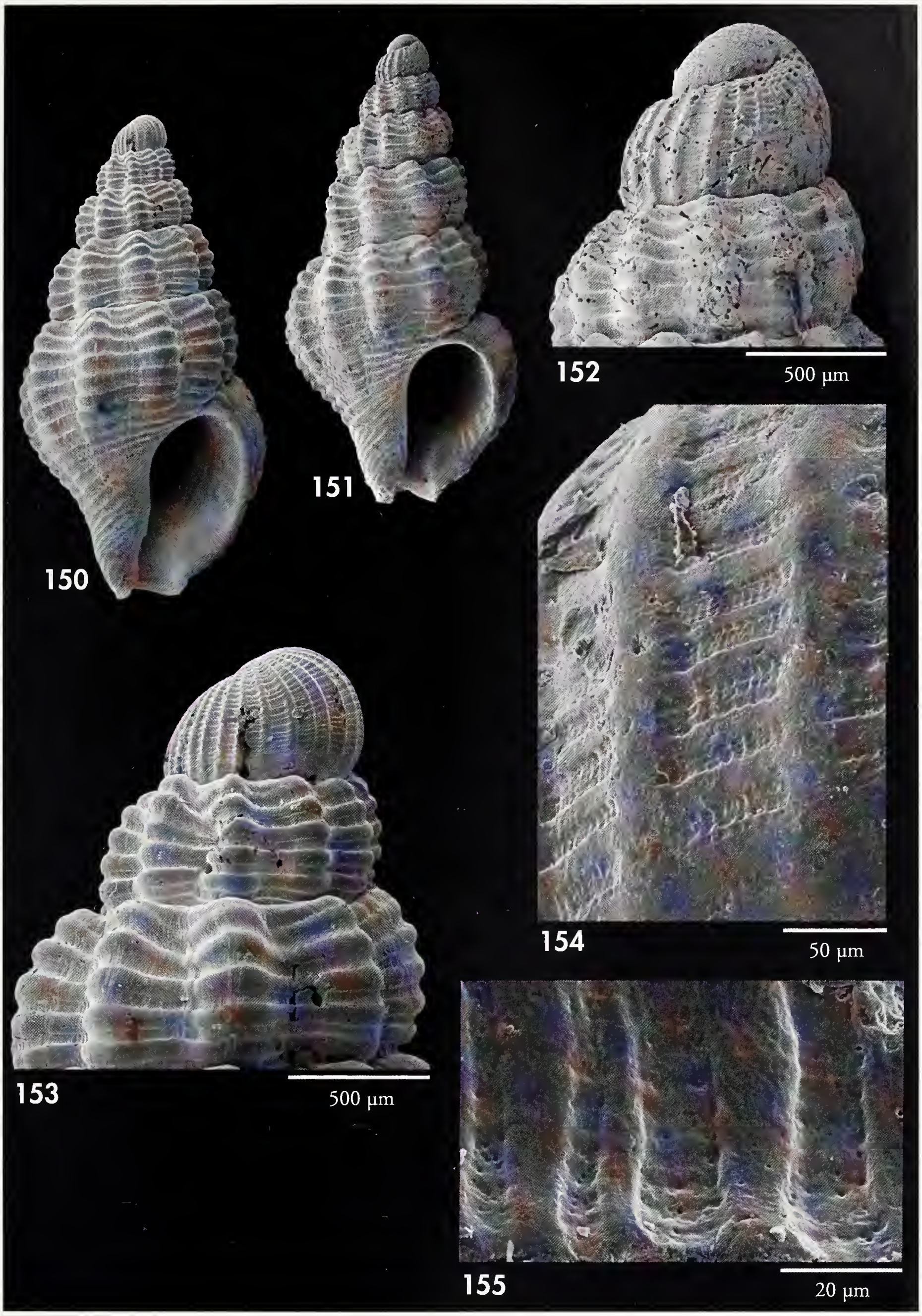
Comentarios: La forma y escultura de la protoconcha la relacionaría con el grupo de *C. javieri*. Pero no se trata de una mera variedad de aguas profundas sino de una especie con entidad propia.

La curvatura regular de las vueltas, su sutura profunda y su canal sifonal claro son caracteres que no se dan juntos en otras especies del grupo. Así *C. javieri* no tiene las vueltas tan convexas ni un canal sifonal claro, además de tener los cordones espirales más anchos que los interespacios. *C. peculiaris* spec. nov. tiene menos cordones espirales en la teleoconcha (cinco en la última vuelta por encima de la inserción labial) y su canal sifonal es más corto.

Chauvetia borgesi spec. nov. (Figs. 60-65, 144-155)

Material tipo: Holotipo (Figs. 60, 61) en MNCN (15.05/51088). Paratipos en las siguientes colecciones: MNHN (1) (Figs. 62, 63), de la localidad tipo; BMNH (1), Fuerteventura, 10 m; MHNS (5): 1 c, Gando, Gran Canaria (Fig. 145); 1 c, Sardina, Gran Canaria (Fig. 144); 1 c, Arrecife, Lanzarote: 2 c, Sahara Occidental, 23° 15′ N, 16° 40′ W, y 22° 05′ N, 16° 58′ W) (Fig. 150, 151); CPR (1) Sahara Occidental, 23° 15′ N, 16° 40′ W; CHO (11: 8 c, Sardina, 15 m; 1 c, Bañaderos, Gran Canaria; 1 c, Roques de Taliarte, 23 m; 1 c, Arinaga); CPB (24 ej y c: Punta Teno, Tenerife); CFS (1) Arrecife, Lanzarote.
Material estudiado: CANARIAS: Gran Canaria: 1 c, Playa Honda (CFS); 1 j, Arguineguín (CHO); 1 j, Playa del Hombre, 80 m (CFS); 1 c, 3j, NO Gran Canaria (CHO); 11 c, Arinaga, SW Gran Canaria, 5 m (CFS); 2 c, Sardina, 15 m (CHO); 1 ej, 3 c, Sardina, 17 m (CHO); 1 c, C0005 (CHO); 2 j, Gando 8-24383, 12 m (CHO); 1 j, Caleta Abajo (CHO); 2 j, C0020a (CHO); 5 j, NO Gran Canaria, 100 m (CFS); 2 j, RH-I/30008, 85 m (CHO); 2 j; El Cabrón (CFS); 2 c, lote 275, C0025 (CHO); 3 c, C0001 (CHO); 1 c, C0022 (CHO); 1 j, FH89 (CHO); 1 c, 1 j, Las Burras (CFS); 1 j, FH67 (CHO). Fuerteventura: 1 c, Granillo (CHO); 1 j, Taliarte, 200 m (CFS); 1j; Las Salinas, 40 m (CFS). Lanzarote: 2 j, Playa Honda (CFS); 1 c, Playa Honda, Arrecife (CHO); 3 ej, C0005 (CHO); 2c, C0005 (CHO); 1 c, C0014 (CHO). Tenerife: 10 j, Punta Teno (CPB). SAHARA: 1 c, lote 201, 22° 05′ N, 16° 58′ W (CHO); 1 j, lote 208, 22° 35′ N, 16° 58′ W (CHO); 1 c, lote 212, 23° 15′ N, 16° 90′ W (CHO). MAURITANIA: 1 j, MM1730 (CHO).
Localidad tipo: Gando, Canarias, 6 m.
Etimología: La especie se dedica a José Pedro Borges, malacólogo portugués que colaboró con la aportación de material de Canarias y de otras zonas próximas.

Descripción: Concha (Figs. 60-65, 144, 145, 150, 151) fusiforme, sólida, con unas seis vueltas de espira. Protoconcha (Figs. 146, 147, 152, 153) con 0,75



Figuras 150-155. *Chauvetia borgesi* spec. nov.; material de Sahara; 150, 151: paratipos, 5,9 mm, 23º 15' N, 16º 40' W, Sahara (MHNS); 5,1 mm 22º 05' N, 16º 58' W, Sahara (MHNS); 152, 153: protoconchas; 154, 155: microescultura de la protoconcha.

Figures 150-155. Chauvetia borgesi *spec. nov.; material from Sahara; 150, 151: paratypes, 5.9 mm, 23º 15' N, 16º 40' W, Sahara (MHNS); 5.1 mm 22º 05' N, 16º 58' W, Sahara (MHNS); 152, 153: protoconchs; 154, 155: microsculpture of the protoconch.*

vueltas, y con una anchura de unas 700 μm (núcleo: 380 μm, primera media vuelta: 600 μm) y unas 700 μm de altura. Escultura (Figs. 154, 155) formada por unos 15 cordoncillos espirales cruzados por unas 18 costillas que se inician a partir del mismo núcleo y que son más estrechas que sus intervalos.

Teleoconcha con una escultura de cordones espirales de anchura parecida (aunque los superiores son algo más estrechos) y claramente más anchos que sus interespacios. Las costillas pueden ser de anchura similar a los interespacios, algo más estrechas o algo más gruesas en cuyo caso la escultura axial es más prominente. En el inicio de la teleoconcha aparecen cinco cordones espirales siendo el superior el reborde de la espira. En la última vuelta hay seis cordones por encima de la inserción labial de los que los dos superiores son de menor anchura y suelen aparecer juntos. Hacia la base, aparecen de una docena de cordoncillos más. La escultura axial está formada por costillas convexas algo prosoclinas (algunas levemente sigmoideas), una decena en la última vuelta que apenas se prolongan por debajo de la inserción labial. La ultima vuelta ocupa el 60 % de la altura total de la concha.

Abertura (Figs. 148, 149) oval que alcanza el 41% de la altura de la concha. En el interior del labio externo se aprecian siete u ocho dientes constituyendo el inferior el borde externo del canal sifonal, que es corto y bastante abierto.

Coloración de la concha: Puede ser marrón oscuro o amarillenta. En algunas conchas de color marrón oscuro puede aparecer una banda blanca subsutural que afecta a los dos o tres cordones espirales superiores.

Dimensiones: Holotipo 7,0 x 3,4 mm; paratipos de unas dimensiones similares, alguno ligeramente mayor, de hasta unos 8 mm.

Animal (Figs. 158, 159): Color crema anaranjado con puntos amarillentos; sifón grisáceo.

Distribución: La especie está presente en Canarias y en las costas del Sahara Occidental y Mauritania.

Comentarios: Por su protoconcha, esta especie estaría relacionada con las del grupo de *C. javieri*. Se diferenciaría de *C. javieri* por tener una escultura más marcada, menos cordones espirales, por su aspecto más rechoncho y por presentar menos dientes en la abertura. Además la protoconcha de *C. borgesi* spec. nov. presenta menos costillas que más voluminosas que las de *C. javieri*. De *Chauvetia peculiaris* spec. nov. y de *Chauvetia edentula* spec. nov, especies que también presentan protoconcha del mismo estilo, se distingue por no tener tan definido el canal sifonal.

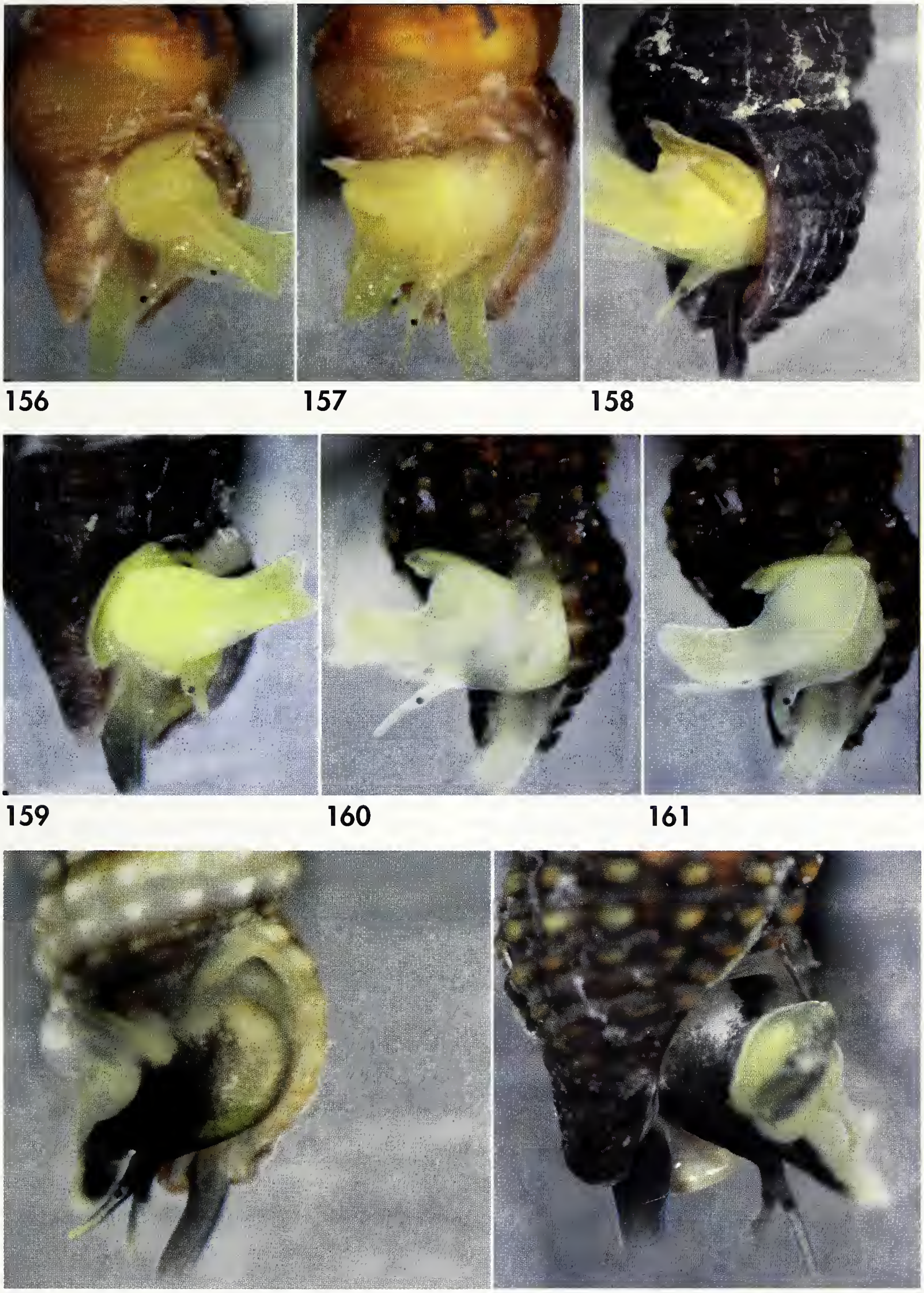
Sin embargo la especie más parecida, y con la que puede originar confusión su diferenciación, debido tanto a su aspecto general y color, a su abundancia y a que comparten área de distribución es *C. crassior*. La diferencia determinante es la escultura de su protoconcha ya que *C. crassior* no presenta costillas en la parte inicial de la misma. Si una concha carece de protoconcha puede resultar difícil de determinar su identidad, si bien la abertura de *C. crassior* suele ser más cuadrada que la de *C. borgesi* y su concha presenta menos cordones espirales.

Aunque se ha apreciado en el material estudiado que la protoconcha de los ejemplares de Canarias tiene menos costillas que los del Sahara y que la teleoconcha presenta menos cordones por encima de la inserción labial (cinco frente a seis) no parecen diferencias importantes y se consideran dentro de la variabilidad intraespecífica.

COMENTARIOS FINALES

Otros taxones mencionados para Canarias:

Chauvetia candidissima canarica Nordsieck y García-Talavera, 1979 (Fig. 66). En el trabajo de descripción aparecen mencionadas unas dimensiones de 7 x 3,5 mm para esta especie. Localidad: La Gomera. El lote de tipos está formado



156 157 158 159 160 161 162 163

Figuras 156-163. Partes blandas de especies de *Chauvetia* de Canarias, Punta Teno, Tenerife (CPB). 156, 157. *Chauvetia crassior*. 158, 159. *Chauvetia borgesi*. 160, 161: *Chauvetia* cf. *affinis*; 162, 163: *Chauvetia affinis*.

Figures 156-163. Soft parts of Chauvetia *species from Canarias, Punta Teno, Tenerife (CPB). 156, 157:* Chauvetia crassior. *158, 159:* Chauvetia borgesi. *160, 161:* Chauvetia *cf.* affinis*; 162, 163:* Chauvetia affinis.

por dos conchas aparentemente diferentes, una de ellas muy erosionada, tanto la concha como la protoconcha y sólo se puede apreciar el patrón de color a bandas. La otra, que se corresponde con la figura representada en la descripción original, tienen una altura de 5,5 mm, la protoconcha está desaparecida. Por la falta de datos es imposible definir la especie, hasta que se pueda estudiar más material de la localidad tipo, pero parece distinta a cualquiera de las que están representadas en nuestro material.

Chauvetia elongata Nordsieck y García-Talavera, 1979 (Fig. 67). Este taxon aparece en el trabajo de descripción original con unas dimensiones de 10 x 3,5 mm, y su procedencia del Sur de Gran Canaria. El holotipo existente en el MNHC tiene una máxima dimensión de 8,8 mm, y la protoconcha está fuertemente erosionada, por lo que no se puede hacer la comparación con *Chauvetia lefebvrii* y *C. retifera*, que son las especies con las que tiene un mayor parecido morfológico. En cualquier caso, después del examen de grandes cantidades de material procedente de Canarias se puede afirmar que estas dos especies no parecen estar presentes en las islas por lo que es posible que este holotipo proceda de material introducido por barcos de pesca.

De las nuevas especies recuerda lejanamente a *C. austera* spec. nov., pero en esta última las vueltas son más convexas, los cordoncillos espirales tienen interespacios más anchos, y el número de estos cordoncillos en la última vuelta es menor.

Por otra parte, existe un taxon con el nombre: *Donovania mamillata* var. *elongata* Locard y Caziot, 1900 pero se trata de un *nomen nudum*.

Distribución de las especies estudiadas

En el presente trabajo, que comprende las áreas de Canarias, Mauritania y Sahara, se han estudiado 18 especies, de las cuales ya tenían nombre 9 de ellas, mientras que otras 9 han sido ahora descritas como nuevas, recibiendo el correspondiente nombre.

El área de distribución de las especies ha sido muy variable. Cinco de estas especies ya eran conocidas del trabajo anterior, que había sido centrado sobre la zona de Dakar, Senegal. Alguna de ellas, como *C. tenebrosa*, era más abundante en Senegal, aunque su área se extiende ahora hasta Mauritania. Otro tanto cabe decir de *C. lamyi* y *C. javieri*, pero en estas últimas, la zona de mayor densidad de población es el Sahara. *C. joani* parece distribuirse tanto por Senegal como por Mauritania. Caso especial ha sido *C. errata* spec. nov. que, pese a su mayor abundancia en Senegal, en el trabajo anterior se la consideró como una especie ya descrita perteneciente a un determinado taxon, mientras en el presente trabajo, después de precisar más su estudio, se le da nombre como especie nueva.

Las especies que se han encontrado con una mayor incidencia en las Islas Canarias han sido: *C. affinis*, muy abundante (también presente en Sahara y norte de Marruecos); *C. crassior*, también muy abundante y encontrada también en el Sahara y del Sur de la Península Ibérica (aunque esta población es algo distinta morfológicamente). En cambio *C. procerula* y *C. mamillata*, han aparecido en escasa cantidad, y su área de distribución se extiende al Mediterráneo. Finalmente, dos de las especies nuevas, *C. edentula* y *C. borgesi*, se han encontrado en Canarias, no en gran abundancia y comparten área de distribución con Sahara.

El Sahara parece ser el área en la que existe una mayor número de especies: 13. Además de las ya mencionadas *C. mamillata*, *C. affinis*, *C. crassior*, *C. lamyi*, *C. javieri*, *C. edentula* spec. nov. y *C. borgesi* spec. nov., se han encontrado las siguientes: *C. lefebvrii*, que también se encuentra en el Atlántico de la Península Ibérica y en el Mediterráneo; *C. hernandezi* spec. nov. y *C. distans* spec. nov. que también se han encontrado en Mauritania, aunque en mucha menor cantidad; *C. gigantissima* spec. nov., *C. austera* spec. nov. y *C. peculiaris* spec. nov. aparecen como exclusivas de esta zona.

Mauritania tiene nueve especies, casi siempre compartidas con el Sahara (C.

hernandezi spec. nov., *C. distans* spec. nov.; o con el Sahara y Senegal: *C. javieri* y *C. lamyi*. Con Canarias y Sahara: *C. borgesi* spec. nov. Con Senegal comparte: *C. joani, C. tenebrosa*, y *C. errata* spec. nov. La única especie que sólo se ha encontrado en estas costas ha sido *C. megastoma* spec. nov.

Morfología de las conchas: algunas conchas tienen un evidente parecido pudiendo agruparse con las que le son más próximas. Algunos caracteres de la protoconcha parecen importantes en la diferenciación:

Es evidente que se pueden formar algunos grupos en base a la escultura axial de la protoconcha:

1- con costillas axiales bien diferenciadas y separadas, y casi sin escultura espiral: *C. tenuisculpta*.

2- con costillas axiales en la protoconcha pero muy próximas y numerosas, y escultura espiral clara: *C. javieri, C. megastoma, C. austera, C. peculiaris, C. edentula*.

3- sin costillas axiales en la mayor parte de la protoconcha, aunque están presentes en el final: a este grupo pertenecen la mayoría de las especies conocidas del género.

En las conchas que no tienen escultura axial en la protoconcha y en cambio tienen escultura espiral fina las hay que presentan:

1- apenas hay escultura axial: *C. gigantea, C. multilirata*,

2- hay escultura axial pero muy poco definida: *C. tenebrosa, C. pelorcei, C. robustalba*,

3- hay excavaciones muy regularmente dispuestas entre los cordoncillos espirales: la mayoría de las restantes especies.

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Jesús Méndez e Inés Pazos hicieron las fotografías al microscopio electrónico de barrido en el Centro de Apoyo Científico y Tecnológico a la Investigación (CACTI) de la Universidad de Vigo.

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FÉ DE ERRATAS DEL TRABAJO ANTERIOR

Oliver y Rolán (2008). Las especies del género *Chauvetia* (Gastropoda, Neogastropoda) del área de Dakar, Senegal, África occidental, con la descripción de diez especies nuevas. *Iberus*, 26 (2): 133-175

En este trabajo, una especie cambió de consideración en el curso del mismo, pero en algunos lugares quedó con el nombre anterior, por lo que se indican aquí esos errores para su corrección.

Pag. 168 2ª columna línea 4
Pag. 170 2ª columna línea 6
Pag. 170 2ª columna línea 9
Pag. 174 1ª columna línea 14
Pag. 174 1ª columna línea 24

Dice en todas *C. candidissima* y debería decir *C. gigantea*

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Páginas siguientes. Incluirán el resto del artículo, que debe dividirse en secciones precedidas por breves encabezamientos. Siempre que sea posible, se recomienda seguir el siguiente esquema: Introducción, Material y métodos, Resultados, Discusión, Conclusiones, Agradecimientos y Bibliografía. Si se emplean abreviaturas no habituales en el texto, deberán indicarse tras el apartado de Material y Métodos.

• Las notas breves deberán presentarse de la misma forma, pero sin resumen.

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Dendrodoris limbata (Cuvier, 1804)

Sinonimias

Doris limbata Cuvier, 1804, *Ann. Mus. Hist. Nat. Paris*, 4 (24): 468-469 [Localidad tipo: Marsella].

Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop.-Car.*, 10: 275.

Dichas referencias no deberán incluirse en la lista de Bibliografía si es la única vez que se nombran en el texto. Si se incluyen una lista completa de referencias de un taxón inmediatamente tras éste, deberá seguirse el mismo esquema (sin incluir en Bibliografía las referencias que no se mencionen en otro lugar del texto).

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Ros J. 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoológica*, 3 (5): 21-51.

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